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Contracting Officer Workload and Contractual Terms: Theory and Evidence

30 August 2012

by

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Department of Economics

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14. ABSTRACT

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Abstract

This paper investigates the relationship between endogenously incomplete contracts and the selection of procurement terms. We take advantage of variation in the workload of contracting officers to estimate the relationship between contractual incompleteness and procurement outcomes such as the use of competitive acquisitions procedures and the risk of renegotiation. In a sample of 150,000 contracts from 85 civilian procurement offices over 11 years, we find that shocks that increase the cost of writing complete contracts, such as increases in contracting officer workload, lead to decreased reliance on competitive acquisition procedures, decreased reliance on firm-fixed-price contracts, increased risk of renegotiation, and higher total costs of procurement. In a sample of 4.6 million contracts from 32 DoD procurement offices over six years, we find that increases in the cost of writing complete contracts lead to decreased reliance on competitive acquisition procedures, increased reliance on firm-fixed-price contracts, increased risk of renegotiation, and increased total costs of procurement. Although the effect of limited acquisitions capacity on contingency contracts in Iraq and Afghanistan has generated a lot of concern recently, we find that, if anything, these contracts are a little less responsive to workload. The DoD's acquisitions manpower has not kept up with the exceptional growth in the level of acquisitions contracting over the past decade. This paper clarifies some of the potential economic consequences of the resulting increase in workload faced by DoD contracting officers.

Keywords: Workload, Contracting, Procurement

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A man who is very busy seldom changes his opinions.

– Friedrich Nietzsche (**ALL TOO HUMAN,** 511; 1908)

Composing a carefully constructed and detailed contract takes time, both in planning and execution. A contracting officer who has a limited time budget must divide his time among the contracting tasks at hand. If the number of tasks increases, less time will necessarily be devoted to each, often leaving some contingencies unaddressed. The choice to leave contracts less and less complete may also affect other procurement terms: pricing structure, extent to which the contract is competed, and even the final price paid. This paper examines the effects of an exogenous shift in the cost of contractual completeness, induced by shocks to workload, on both completeness itself and other related procurement features.

This report is divided into two major sections: civilian and DoD. We begin with the civilian analysis, since the dataset is a little broader and suffers from fewer identification problems. We then turn to the DoD analysis which mirrors that conducted in the civilian context. The results of the two are broadly consistent: busier contracting officers write contracts that are more likely to be renegotiated at a later date, use less competitive acquisitions procedures, and obligate more money. The only conflict between the civilian and military analysis is in the pricing terms—in the civilian context, busier contracting officers use more cost-plus contracts, while busier DoD contracting officers use more firm-fixed-price contracts.

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CIVILIAN ANALYSIS

Introduction

After briefly outlining the procurement process in the U.S. federal government, we build a model that extends a simple version of Bajari and Tadelis (2001) to understand the choice of contractual completeness and contractual terms in the presence of varying workload.

This model predicts that busier contracting officers choose to write less-complete contracts, leading to more renegotiations as unspecified eventualities arrive. Anticipating these costly renegotiations, the officers decrease their use of fixed-price contracts, which are more difficult to renegotiate than cost-plus contracts. Since the specified features of the contract form the basis for competition, less complete contracts decrease the benefits of competition, so busier contracting officers use less competitive procurement mechanisms. Finally, busier contracting officers actually end up paying more for a given project, in expectation, because renegotiation is costly, cost-plus contracts give little incentive for cost-saving effort, and less competitive acquisition procedures lead to less efficient selection of contractors.

With this model to structure the investigation, I analyze a sample of 150,000 contracts from a panel of 85 civilian federal procurement offices over 11 years. Exogenous shocks that increase the cost of writing complete contracts, such as increases in contracting officer workload, decrease the use of competitive acquisition procedures, decrease the use of firm-fixed-price contracts, increase the risk of renegotiation, and lead to higher total costs of procurement. Each of these results is consistent with the predictions of the model.

These results shed new light on a number of important questions about the causes and effects of incomplete contracting. Most extant studies, summarized in

the section Determinants of Procurement Terms, either take the degree of completeness as exogenous or look for differences in completeness induced by the underlying complexity of the project. Since the variation in completeness here is induced by a completely different source (workload), the set of potential confounders is quite different, so the broad consistency of the results presented here with that earlier literature should be reassuring. Furthermore, I provide a comprehensive framework for understanding the codetermination of contractual completeness and many contractual/procurement terms. This framework can unify the constellation of disparate results in the literature that look at the effects of completeness on one particular contractual feature at a time.[1]

In addition to contributing to the academic literature on the causes and effects of incomplete contracting, in this paper I also address a pressing policy question. The U.S. federal government, over the past decade, has been faced with exactly this situation. From FY2000 to FY2010, the total spending on U.S. federal procurement contracts grew from just over $200 billion to over $500 billion (FPDS-NG). After accounting for inflation, this growth represents more than a doubling of real contractual expenditures. In this same period, the relative importance of procurement in the total federal budget has also grown. In FY2000, contracting made up 12% of total federal expenditures, while by FY2010 it had risen to 22% (Census, 2011).

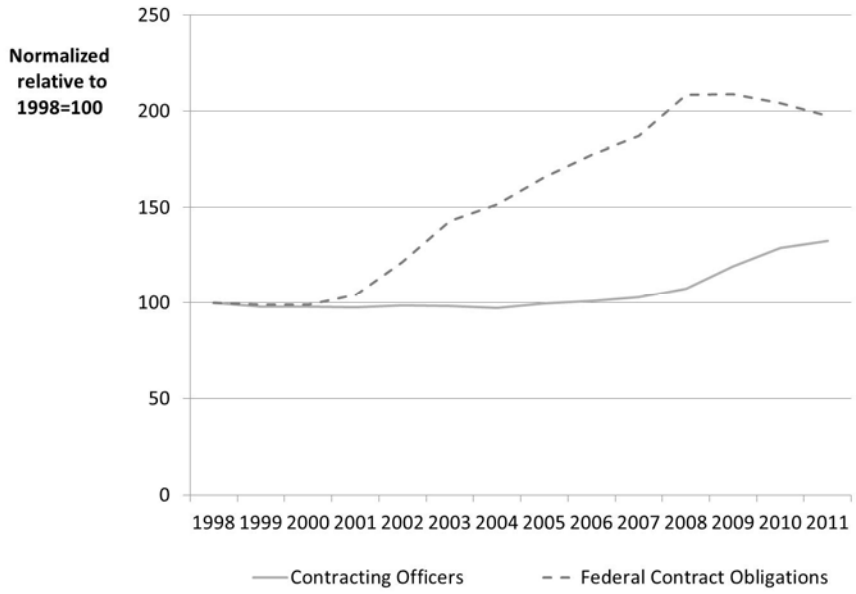
Despite the dramatic growth in procurement contracting, there has been no concomitant growth in the number of contracting personnel. In FY2000, there were 26,588 contracting officers (occupational designation GS-1102) government-wide. By FY2010, the workforce had increased to 35,707, an increase of only 34%. Over the same period, the number of procurement assistants (GS-1106) actually fell, from 3,635 to 1,664 (OPM, FedScope). Figure 1 presents these trends graphically. In

[1] For another very recent synthetic framework, see Tadelis (2012).

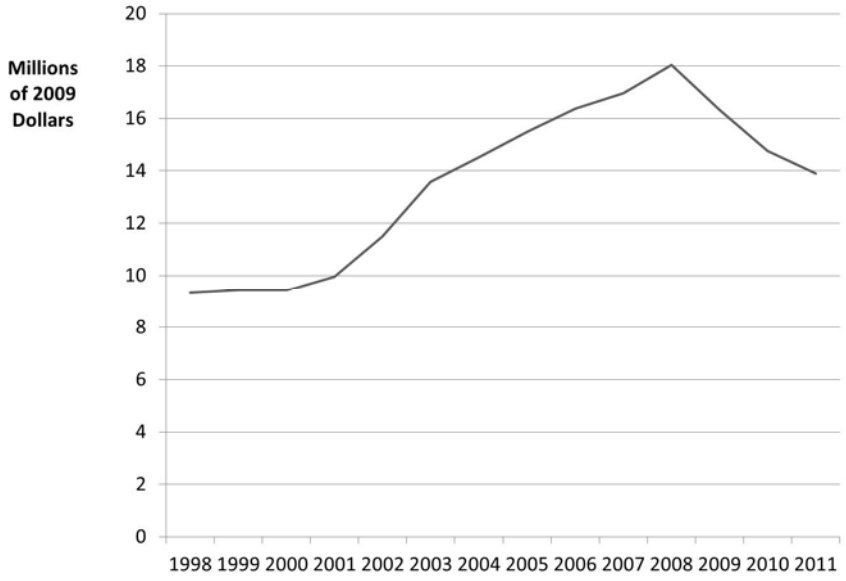
panel A, obligations and contracting officers in 1998 are normalized to 100, while panel B illustrates the growth in real procurement spending per contracting officer.

Figure 1. Workload Trends over Time

Panel A. Normalized Nominal Obligations and Contracting Officers



Panel B. Real Obligations per Officer



Note. Contracting officer employment is total federal GS-1102 employment indicated for the fiscal year. Total contractual obligations are from FPDS-NG and summarized by www.usaspending.org. Real obligations were deflated to 2009 dollars by the CPI.

Concern about the strain of increased contracting in an environment of relatively fixed contracting capacity has been present within the acquisitions community for some time.[2]

Potential negative consequences include fraud vulnerability, insufficient oversight, problems with cost or quality certification, dependence on excessively simplistic or boilerplate contracts, weak bargaining in negotiated contracts, and excessive dependence on private contractors to perform contracting functions. This concern has some anecdotal support at the level of individual investigations and

[2] See the *Report of the Acquisition Advisory Panel to the Office of Federal Procurement Policy and the United States Congress* (Acquisition Advisory Panel, 2007), Chapter 5, for an overview, as well as a large body of work by the GAO: *High-Risk Series: An Update* (2005a); *DoD Acquisitions: Contracting for Better Outcomes* (2006c); *Contract Management: DoD Vulnerabilities to Contracting Fraud, Waste and Abuse* (2006b); *Defense Acquisitions: Assessments of Selected Major Weapon Programs* (2006a); *Defense Acquisitions: DoD Has Paid Billions in Award and Incentive Fees Regardless of Acquisition Outcomes* (2005c); *Defense Management: DoD Needs to Demonstrate that Performance-Based Logistics Contracts are Achieving Expected Benefits* (2005b).

surveys of acquisitions professionals.[3] The concern led to a push to increase contracting capacity, especially within the DoD. But the magnitude and direction of any effect of binding contracting capacity on contractual outcomes has not been subject to rigorous theoretical and statistical investigation. This is the first such evaluation.

In the rest of this section, I put the paper in context, both in terms of the existing literature and the policy environment. In the Modeling the Procurement Process section, I build a model of the effects of workload on contractual completeness and contract/procurement terms and derive some testable implications. In the Civilian Data and Methodology section, I discuss the data and the empirical approach. In the Civilian Results section , I present the empirical results, and in the Summary of Civilian Analysis section, I briefly conclude.

Determinants of Procurement Terms

The economics literature on the determinants of contractual form is quite robust and mature. For a summary, see Lafontaine and Slade (in press). In the particular case of procurement contracts, several papers have investigated the determinants of the specific features examined here. I review those results in the following paragraphs. The overarching approach taken in this paper, where contractual completeness is endogenously determined and, in turn, affects the other contractual provisions, was pioneered by Goldberg (1977) and formalized by Bajari and Tadelis (2001).

This framework has been used to investigate the decision to open a contract to competition, often couched in terms of "auctions versus negotiations." In the context of private construction contracts, Bajari, McMillan, and Tadelis (2008) find that more complex projects are procured less competitively and, holding complexity

[3] See, for example, Rau and Stambersky (2009), who find that less than 15% of senior contracting officers surveyed at the Army Contracting Command felt that there were an adequate number of acquisition management positions in their installation. Furthermore, only 23% felt that service contracts were afforded the proper level of oversight to monitor contractor performance.

fixed, competitive procurements are more likely to be renegotiated. Gil and Oudot (2008) find similar results in the context of French defense procurements, at least within a given buyer-seller relationship, as do Leffler, Rucker, and Munn (2007), in the context of private timber sales. All these papers look at how the use of competitive procurement methods is affected by differences in completeness driven by the underlying difficulty of the project. My approach is different because I look for differences in completeness induced by exogenous variation in the opportunity cost of the contracting officer's time due to changes in workload. Nevertheless, the results are quite consistent with the existing literature.

Parallel to the literature on "auctions versus negotiations" is the literature on pricing terms, often characterized as "fixed-price versus cost-plus." In the context of timber auctions, Leffler and Rucker (1991) find that simpler-to-specify tracts are more likely to be sold at fixed prices. Kalnins and Mayer (2004) find that when quality is difficult to measure, and, therefore, difficult to contract on, the IT services industry uses more cost-plus contracts. Corts and Singh (2004) find that oil exploration companies increase their use of cost-plus contracts for drilling contractors as their experience with those contractors grows and posit that this change occurs because opportunities for repeat business strengthen the incentives for efficiency more than they reduce the costs of specifying complete contracts. Crocker and Reynolds (1993) find the opposite pattern, in the context of Air Force engine procurement, and argue that as the buyer gains more information over time it becomes easier to write complete contingent contracts. The approach in Crocker and Reynolds (1993) is closest to this paper, in that they identify how changes in the contracting agencies' ease of writing complete contracts affects the pricing methods chosen. They focus on a single agency and a very specific type of contract, but the results from my broader panel IV approach are quite similar.

Finally, a very few studies have directly targeted the question of the costs and incidence of renegotiation and contractual incompleteness, independent of the contractual terms outlined in the previous paragraphs. Guasch, Laffont and Straub

(2008) find that concession contracts in Latin America are more likely to be renegotiated if the firm is not regulated or if the quality of the bureaucracy that oversees the concession is low. Bajari, Houghton, and Tadelis (2010) use a structural approach to analyze a set of California Highway Procurement auctions and find that the ex-post adaptation costs make up between 7 and 13% of the winning bid. Consistent with these results, I find that decreasing workload leads to less frequent renegotiation and lower prices.

By contrast to the extensive research on contractual incompleteness and procurement terms, the formal literature on the effects of workload specifically is sparse. A large literature exists on the measurement of workload, which I reference when discussing my own approach. There has been some work on the role of contracting capacity in the context of local and municipal governments in the public administration literature, but this literature has concerned itself primarily with the determinants of contracting capacity rather than its effects and has been mostly qualitative in nature. See, for example, Brown and Potoski (2003), and Yang, Hsieh, and Li (2009).

In summary, this paper sits squarely in the broad literature that examines the causes and effects of incomplete contracts. It uses a novel source of identification, workload, which may be of independent interest, and it relies on a uniquely extensive set of contracts. The results fit nicely with the existing literature, simultaneously confirming many of the general findings about the effects of incomplete contracting on contractual and procurement terms, under different identification conditions, while bringing them into a common framework.

The Civilian Procurement Process

The U.S. federal government's procurement process progresses in three stages. It begins with the identification of a need and a contract planning process. It

continues with the solicitation and award stage, and ends with the contract management and closeout stage.[4]

In the first stage, the agency determines it has some need to perform its mission that it cannot fulfill with its current resources. If an analysis of this need determines that a procurement is the appropriate response, the procurement process begins. A contracting officer (or his delegate) designs a procurement strategy in light of authorizing legislation, the agency's needs, market conditions, and the dictates of the Federal Acquisition Regulation (FAR, 2012) and agency-specific acquisition regulations. At this point, the agency decides the degree and method by which the contract will be competed, the form of pricing appropriate to the contract, and whether the contract will be for a definitive quantity or some indefinite delivery vehicle.

Once it is determined which contractual forms and procurement mechanisms are appropriate, the agency moves to the second stage of the process. If the contract is expected to be above $25,000, the agency solicits offers through various channels, including the Federal Business Opportunities website. The solicitation outlines, at a minimum, a description of the agency's needs, the format that offers should take, who is allowed to make an offer, and the method by which those offers will be evaluated. Offerors respond to this description as appropriate. Responses may be a simple price bid, a more complicated proposal, or even entering into a bilateral or multilateral negotiation including exchanges of proposals and responses with the agency. These offers are evaluated in accord with the provisions outlined in the original solicitation and an award is made.

Once the contract is awarded, the agency moves into the third stage of the process, contract management. The contractor begins work on the project, and the agency oversees this effort as appropriate. This oversight may include inspection for

[4] Adapted from the *Contracting Officer's Technical Representative (COTR) Training Blueprint* (Federal Acquisition Institute, Office of Governmentwide Policy, & General Services Administration, 2003, pp. 27–30), formerly called the *Contracting Officers Representative (COR) Workbook*.

quality, adherence to specifications, and auditing of costs. It is at this stage, as well, that unanticipated problems may arise, leading to modifications of the original contract. Depending on the degree and reason for the modifications, the result may be simple unilateral modifications or bilateral agreements that require some equitable adjustment to pricing. Finally, the contract will come to an end, and the relationship between the contractor or agency will be complete. This can occur either because the terms were satisfied or because the contract was terminated by the agency for any number of reasons, including convenience and misconduct.

Throughout this entire process, the government's primary representatives are civil service employees in the occupational series GS-1102, broadly referred to as contracting officers. The Position Classification Standard for the Contracting Series (Office of Personnel Management [OPM], 1983) describes their role as follows:

> This series includes positions that manage, supervise, perform, or develop policies and procedures for professional work involving the procurement of supplies, services, construction, or research and development using formal advertising or negotiation procedures; the evaluation of contract price proposals; and the administration or termination and close out of contracts. The work requires knowledge of the legislation, regulations, and methods used in contracting; and knowledge of business and industry practices, sources of supply, cost factors, and requirements characteristics. (p.3)

These agents are assisted in their task by a number of support personnel, including purchasing officers (GS-1105s, who concentrate on simplified acquisitions), procurement clerical and assistance series employees (GS-1106s, who provide clerical support), and contracting officer representatives and contracting officer technical representatives (various series, who develop the contracts' technical requirements and determine if a contractor meets them). I will use ceteris paribus variation in the number of the (GS-1102) contracting officers to measure changes in workload.

In the next section, I construct a formal model that includes the key features of this formal procurement process in order to trace the effects of a shock to workload on procurement and contracting decisions.

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Modeling the Procurement Process

To structure the investigation of the effects of contracting officer workload, I present here a model of the procurement process with endogenous contractual design. This model builds on the analysis in Bajari and Tadelis (2001) of the choice between fixed-price and cost-plus contracts. Consistent with that model, I focus on the trade-off between cost-saving effort with fixed-price contracts and ease of renegotiation with cost-plus contracts, and on how this trade-off is affected by the endogenous choice of contractual completeness. But rather than derive the trade-off from first principles, I include a simplified version of this finding as an assumption in the model and leave the interested reader to follow up on the micro- foundations in the original. Instead, I broaden the analysis to also investigate the choice between competitive procurements and limited-source negotiations. In this second dimension, the trade-off is slightly different between the cost of implementing and documenting a competitive procurement and the benefit of selecting the ex-ante lowest cost producer. Again, the endogenous choice of contractual completeness will interact with this trade-off, since finding the lowest cost producer of the specified product is only useful if the product is correctly specified.

Primitives

Players and Payoffs

The central actor in the model is the contracting officer. The total payoff of the contracting officer depends on three elements: the value they receive from the product or service, net of payments to the contractor; the cost of specifying contractual contingencies; and the cost of running a procurement competition.[5] Assume that the product or service is valued by the contracting officer at some dollar value, $v > 0$. If the final outlay for the contract is p, his net value is given by $v - p$.

[5] In reality, the contracting officer is an agent in a bureaucracy, so will not be residual claimant. For simplicity, I ignore this complication and simply assume he is facing some set of incentives that leads him to value saving time and money on the project and on its procurement. Having him only receive a fraction of the net benefit of the project has no effect on the signs of the comparative statics.

The cost of writing a contract that explicitly specifies the contractor's obligations under all possible contingencies would be prohibitive. Instead, the contracting officer will choose a level of contractual completeness $t \in [0,1)$, where the contract covers all circumstances that actually arise with probability t, and with probability $1-t$ some unanticipated event occurs which will require some off-contract performance in order for the agency to receive that value v. The cost of preparing such a contract, in terms of the contracting officer's time and effort, is given by $wd(t)$, where $d(0) = 0, d'(0) = 0, \text{d"}(t) > 0$, and $lim_{t\to 1} d(t) = \infty$. Here, w measures the workload borne by the contracting officer on other projects, so the opportunity cost of his time is higher when the workload is higher.[6] Finally, I assume that there is some additional cost of running a competitive procurement, m, where the cost comes in soliciting and analyzing competitive bids completely and documenting the process carefully.[7] To summarize, the utility of a contracting officer with workload w, expecting to pay price p is given by

$$U(t, compete) = v - p - wd(t) - m * compete$$

The other participants in the model are the contracting firms. I assume there are $N > 2$ potential bidders, indexed by i, and they have initial costs of production c_i drawn from a common distribution $F(\,)$, which is bounded below by zero and above by $\bar{c}$ with expected value $E[c]$. If an unanticipated eventuality arises, the cost of providing the contracted good or service may change. I assume this alternative cost, k, is independently drawn from a distribution, $G(\,)$, bounded below by zero and above by $\bar{k} > \bar{c}$, with expected value $E[k] > E[c]$. I assume that it remains efficient to complete the contract, so $\bar{k} < v$, but on average modifications will be more costly than non-modifications, since some costs will be nonrecoverable. Finally, whichever

[6] I model the effects of workload as a change in an exogenous parameter for simplicity, but it would be easy to provide microfoundations with a model of time allocation among more and more contracts, a fixed time budget, and decreasing marginal value of effort on an outside project.

[7] The real possibility of a bid protest makes the documentation effort especially salient. See, for example, Maser, Subbotin, and Thompson (2011).

cost is realized, the contractor can reduce that cost by putting forth unobservable effort, e, at effort cost, $g(e)$, so if the applicable cost draw is c, the final real cost is $c - e + g(e)$, while the accounting cost is $c - e$. I assume that the costs are such that even efficient effort will never make the expected costs negative. Formally, I define e_{fp} by $g'(e_{fp}) = 1$, and let $f \equiv e_{fp} - g(e_{fp})$ represent the net cost savings of this efficient effort. Fixed-price contracts will induce this efficient effort, but even then expected costs are positive (I assume that $f < E[c]$).

Timing, Negotiation, and Renegotiation

The timing of the model is as follows:

1. The contracting officer decides whether to issue a fixed-price or cost-plus contract, whether to run a competition, and how completely to specify the contract.
2. Bidders make offers as allowed by the procurement provisions, and a winner is selected.
3. Unanticipated contingencies may arise, which lead to renegotiation.
4. The winning bidder makes cost-saving efforts.
5. Final production occurs, and contracts are paid.

Given a contractual form and specification, I assume that competition always takes the form of a second-price or second-cost auction.[8] For a fixed-price contract, this means the lowest bidder wins and is paid the second-lowest bid. For a cost-plus contract, this means that the firm with the lowest cost wins and is awarded a cost-plus contract in which they are fully compensated for all realized costs, plus they are paid a fixed difference between their cost and the second-lowest cost. Absent any changes, this contract would pay them exactly the second-lowest cost. Of course, if actual costs are higher than expected they are paid more, and if actual costs are

[8] This assumption is simply to make the calculation very transparent. First-price auctions would yield identical comparative statics, since (by the revenue equivalence theorem) they yield the same expected cost.

lower than expected, they are paid less. So, for example, if the lowest initial cost was five and the second lowest was seven, the lowest bidder would be awarded a contract paying $2 = C$, where C is whatever the final costs of production are.

For negotiations, the buyer is vested with a very extreme form of bargaining power throughout. This assumption simplifies the analysis and allows us to concentrate on comparative statics with respect to workload. I assume that when negotiation or renegotiation occurs, the buyer will always make a take-it or leave-it offer. I assume that the buyer knows all relevant cost information when making this offer. These assumptions make negotiation/renegotiation more attractive than they are, in practice, but will not affect the change in their relative attractiveness as the workload changes.

Consistent with the results of Bajari and Tadelis (2001), I assume there are some frictions in the renegotiation of fixed-price contracts, so an offer of $\bar{P}$ to the seller actually costs the buyer $(1 + \delta)\bar{P}$, with $\delta > 0$ measuring the friction.[9] Cost-plus contracts, by contrast, are assumed to be completely flexible. If the cost of production goes up or down with a modification, so will the payment, one-for-one.

The Costs and Benefits of Contractual Completeness

Our interest here is understanding the effects of increasing workload on contractual completeness, contract pricing, the decision to compete the contract, and the price paid. Workload only appears in one place in the model, in the marginal cost of contractual completeness. Since contractual completeness is set optimally, an increase in its marginal cost will obviously tend to decrease the equilibrium level of completeness. The effects of workload on all the other contractual choices arise due to the adjustment in optimal completeness.

[9] Perhaps information is not fully available, so there is some monopsonistic inefficiency in the take-it or leave-it offer, whereby inefficiently little trade occurs. Perhaps the process of rewriting a fixed-price contract, itself, involves some extra contracting costs. Different micro-foundations are possible. I simply take this as a working assumption.

Compare, first, the payoffs to fixed-price versus cost-plus contracts. The advantage of fixed-price contracts is the efficient provision of cost-reducing effort by the contractor, since the contractor is residual claimant on any cost savings. The advantage of cost-plus contracts is the ease of renegotiation, by assumption. If there were no chance of unforeseen contingencies, fixed-price contracts would unambiguously dominate, but, as contracts become less and less complete, cost-plus contracts may become optimal. Since increasing workload leads the contracting officer to decrease completeness, cost-plus contracts become attractive as workload increases.

Compare, next, competition versus negotiation. The advantage of negotiation is that the contracting official can forgo the time and cost of conducting a full-and-open competitive procurement. The advantage of competition is that an ex-ante more efficient producer is selected. But this efficiency advantage only occurs in the absence of modification. If modification is certain, negotiation unambiguously dominates since a cost advantage with respect to the initial project c tells us nothing about the final costs, k. As workload lightens, officers choose more complete contracts, and competition may become optimal if the cost advantage is important enough, relative to the costs of running the competition.

Furthermore, both the initial winning bid and final expected payment made by the contracting officer should be increasing in workload. The change in initial bid occurs due to the decreasing use of competition and fixed-price contracts. The effect on final expected payment is even more direct. The reason you write more complete contracts is to decrease the expected amount paid. If less completeness actually led to lower expected payments, the contracting officer should move to those less complete contracts even absent a push from workload. Since completeness declines in workload, expected cost must increase.

The following proposition formalizes these intuitions.

Proposition 1

Let $t*(w,\delta,N)$ represent the equilibrium level of contractual completeness. Let $x*(w,\delta,N)$ represent the equilibrium decision to use a fixed-price contract (where $x=1$ means using a fixed-price contract, and $x=0$ means using a cost-plus contract). Let $y*(w,\delta,N)$ represent the equilibrium decision to run a procurement competition (where $y=1$ means using a competitive procurement, and $y=0$ means single-source negotiating). As workload (w) increases, all three equilibrium choices weakly decrease and expected winning bid and final expected costs increase.

Proof. Appendix

In the empirical analysis in the next section, I investigate all five predictions and find evidence for each.

Civilian Data and Methodology

I construct measures of workload and contractual/procurement terms from a large public database of government contracts. The contract data consist of every transaction above a reporting threshold from FY2000 to FY2010 for 85 civilian agencies, over four million actions in all.[10] Gathered from the Federal Procurement Data System (Next Generation), through www.usaspending.gov, the contract data include procurement contract transactions reported directly through the contract writing systems of the constituent agencies. Each initial government obligation above a reporting threshold ($25,000 before 2005 and $3,000 after) appears exactly one time, as does every modification of a reported contract. Each element includes a broad range of information about the contracting parties, the contractual terms, and the method of procurement. The particular provisions that form the basis for the analysis are discussed in detail in the following paragraphs.

I measure the number of contracting officers in an agency by counting the number of GS-1102s. The data on the GS-1102 employment in each contracting agency in each fiscal year comes from the Office of Personnel Management's Central Personnel Data File. It reports the number of contracting officers in each agency at the end of each fiscal year, by years of experience in that agency, as well as the number of such officers leaving the federal service by reason of departure.

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[10] This consists of every civilian agency/sub-agency that reports non-zero GS-1102s to the Office of Personnel Management and more than 500 contractual actions to the Federal Procurement Data System (Next Generation), with a few exceptions. The following agencies are dropped for irregular reporting with many missing observations. From the DHHS: Program Support Center. From the DoT: Federal Aviation Administration and the Surface Transportation Board. From the GSA: Office of Chief Person Officer, Office of the Inspector General, and Office of Governmentwide Policy. From USDA: Departmental Administration and Agricultural Marketing Service. From Treasury: Secret Service, Federal Law Enforcement Training Center, and Alcohol and Tobacco Tax and Trade Bureau. From Labor: Employment Standards Administration and OSHA. From DoJ: Immigration and Naturalization. Finally, a few agencies enter the sample after the beginning: From USDA, Rural Housing Service in 2003, Natural Resource Conservation Service in 2003, and Office of Chief Financial Services in 2003; from DoJ, ATF in 2003; from Homeland Security, Headquarters in 2005; and from DoT, Pipeline and Hazardous Materials Safety Administration in 2005.

We choose to focus on civilian agencies, despite the fact that defense agencies make up the majority of procurement spending, for three reasons. First, there are many more civilian agencies, allowing for greater variation in workload. Second, all contracting officers in civilian agencies are GS-1102s, while in military contracting offices the procurement work may be shared with career military officers. Finally, there may be differential reporting in defense agencies, where a greater fraction of contracts are classified for reasons of national security. Although I have no reason to believe that the results here would not extend to defense agencies, care should be taken in applying them.

Finally, there are a few cases of agencies moving among departments, passing out of existence, or merging. The most important of these was the formation of the Department of Homeland Security in 2003, and the 2005 merger of the Federal Supply Service with the Federal Technology Service. In all cases, the original and transformed agencies are coded separately, since they may change in unobservable ways as a result of their reorganization.

Contractual Types and Terms

Even within a single agency, contracts vary enormously. I analyze the effects of workload on four endogenous aspects of contracts: competition, pricing terms, modification, and outlays. Of course, the effects of workload may go beyond these simple factors, but I limit my attention to these factors for a first look into the problem. In addition to these endogenous factors, contracts also vary in their exogenous underlying characteristics. It is important for inference to control for these factors as well. I will discuss two important exogenous factors first and then turn to the endogenous outcomes.[11]

[11] A parallel analysis to that conducted in this section for the two simplified contracts types is available from the author. The results are broadly in line with these, with the exception of dollars obligated on delivery orders, which seem to increase with the number of contracting officers. But given the evidence of substitutions, those estimates need to be interpreted with care, since they may suffer from selection bias.

The first exogenous dimension along which contracts vary is the product or service class of the procurement. The General Services Administration divides every product or service purchased by the U.S. federal government into one of 24 services classes or one of 90 product classes.[12] Each contract indicates the primary product/service class of the acquisition. Within civilian agencies some of these classes, such as Nuclear Ordinance, are not represented or very small, so I collapse them into neighboring categories. After these combinations, there are 55 broad product/service categories.[13]

The second exogenous dimension along which contracts vary is the mix of award types. Awards are first divided by whether they specify a fixed quantity (definitive contract) or leave some quantities unspecified (indefinite delivery vehicle). Very small awards (currently below $3,000) are known as "micropurchases," and are exempted from a number of competition and reporting requirements. Finally, purchases above the $3,000 threshold but below the $150,000 simplified acquisitions threshold should be conducted in accordance with simplified acquisitions procedures and are explicitly set aside for small businesses. These awards are known as "purchase orders" and tend to be for very standardized commercially available products or services.[14]

Compared to other features of the contract, the contracting agency has little discretion over the product class and award type, as they are primarily dictated by the nature of the good or service to be acquired. For this paper, I limit my investigation to the effects of workload on the contractual terms of original definitive contracts above the original $25,000 reporting threshold. Below, in Table 2, I provide

[12] For definitions, see *Federal Procurement Data System Product and Service Codes Manual* (GSA, 2011).

[13] Details of matches are available by request.

[14] For details on purchase orders and the simplified acquisitions procedures, see section 13 of the FAR (2012).

evidence that there is little substitution between definitive contracts and other contract award types as a response to changes in workload.

Definitive contracts are a more attractive sample than purchase orders because the contracting and competition process is much more intensive and specialized, and the contracting officer must exercise considerably more judgment and expertise. Definitive contracts are also a more attractive group than calls on indefinite delivery vehicles, because it is clear exactly when the bulk of the contracting work took place. For an indefinite delivery vehicle, the context of the initial umbrella contract is important, but so is the context for each individual specification of a call on that contract, and these two contexts may interact in quite complicated ways. For the same reason, I do not investigate the terms of modifications, per se, other than identifying whether a modification took place, the reason for the modification, and how the modification affected the obligations on the original contract. One could examine, in addition, the pricing terms and competitive terms of the modification, per se, but I do not do so here. Finally, I only look at contracts above the original $25,000 reporting threshold. Some contracts below this threshold are reported, but since the reporting is not obligatory, reporting rates may adjust with workload. My focus on original definitive contracts above the reporting threshold winnows the sample enormously, from over four million total contractual actions to only about 150,000 qualifying contracts.

The first endogenous dimension along which contracts vary is the pricing structure. For modeling purposes, I divide simply between fixed-price and cost-plus contracts. In reality, they are much more finely delineated, including firm fixed price; fixed price with various price adjustments, effort requirements, and incentive payments; cost plus fixed fee; cost plus various incentive fees; time and materials; and various hybrid forms. In the sample of original definitive contracts, firm-fixed-price contracts make up 85% of all contracts. According to the Federal Acquisitions Regulation (FAR, 2012), fixed-price contracts should be used when the contract risk is relatively low, or defined within acceptable limits, and the contractor and the

government can reasonably agree on a maximum price. Official government policy is to prefer firm-fixed-price contracts when possible.[15]

The second endogenous dimension along which contracts vary is the degree to which they are competed. The most open form of competition is termed "Full-and-Open Competition," which refers to any competitive method in which all responsible sources are permitted to compete. It includes sealed bids, competitive proposals, and combinations of competitive procedures. A more limited level of competition is "Full-and-Open Competition after Exclusion of Sources," in which some number of otherwise qualified bidders are excluded from the competition. Such exclusions are primarily set-asides for preferred bidders, such as small businesses, Historically Under-utilized Business Zone (HUBZone) businesses, or service-disabled veteran-owned businesses, but they can also be used if the use would reduce overall costs without harming competition, benefit national defense, ensure a reliable source, or satisfy a critical need. Finally, a contract may not be competed at all, either because its awarding procedure was explicitly specified by statute (Not Available for Competition) or because only one source was solicited for reasons authorized by regulation and justified by the contracting officer (Not Competed). The most common justifications are the following: there is only one responsible source and no other suppliers will satisfy agency requirements, unusual and compelling urgency, and industrial mobilization.

The third endogenous characteristic of original contracts I consider is that some are modified over time and some are not. The reasons for modification vary substantially. About half are strictly administrative, a funding-only action or a close out of a completed contract. But about 45% of modifications are some type of real change in the way the contract will be carried out: unilateral requests for additional work, change orders, the exercise of options, and bilateral supplemental

[15] This policy was recently highlighted by a July 29, 2009, memorandum from the OMB to every chief acquisition officer in the federal bureaucracy requiring the use of firm-fixed-price contracts and competitive acquisitions whenever feasible.

agreements. The remaining 5% are a collection of cancelations, terminations, and movements between definitive and indefinite contracts.

Finally, contracts differ endogenously with respect to size of the government's financial obligation. Every original contract has an initial level of expected obligation, and that obligation can be altered by subsequent modification. I look at both initial and final obligation, individually, since the model predicts effects on each.

Table 1 presents the summary statistics for each of the characteristics for the full sample of contractual actions, for the subsample of original definitive contracts that will form the basis for the regressions below, and for the subset of those which are service contracts. Since services may be particularly difficult to fully specify, they may by particularly responsive to workload. I also consider a "Big Agencies" subsample consisting of the 39 agencies that had more than 500 original definitive contracts over the sample period; they are listed individually in Table 9. Since the "big agency" sample includes 140,000 of the 150,000 qualifying contracts, the summary statistics for it are nearly identical to the overall sample, so they are not presented separately here.

Table 1. Summary Statistics by Subsample

	Full		Orig. Def.		O.D. Services	
Variable	Mean	s.d.	Mean	s.d.	Mean	s.d.
Definitive	0.14	0.35	1	0	1	0
Original	0.39	0.49	1	0	1	0
Orig. Def.	0.035	0.18	1	0	1	0
Measures Of Competition						
Full and Open Comp.	0.61	0.49	0.43	0.50	0.40	0.49
Excl. of Sources	0.089	0.28	0.15	0.36	0.16	0.36
Not Comp.	0.12	0.32	0.15	0.35	0.14	0.35
Contractual Pricing Form						
Firm Fixed	0.65	0.48	0.85	0.36	0.83	0.38
Substantive Changes (Pre-2009)						
Any Mods	n.a.		0.37	0.48	0.43	0.49
Termination	n.a.		0.0079	0.089	0.0080	0.089
# Mods	n.a.		1.33	5.28	1.54	5.71
Obligations ($M2009)						
Init Oblig ($M2009)	0.29	7.09	0.85	17.4	0.86	19.0
Final Oblig ($M2009)	n.a.		2.41	66.1	2.58	71.6
Agency Characteristics (Weighted by Sample Sizes)						
Any Retire	0.90	0.30	0.94	0.24	0.93	0.25
Pct. Retire	0.031	0.030	0.035	0.025	0.034	0.024
Pct. 10–20	0.25	0.10	0.26	0.097	0.27	0.093
Pct. 20+	0.47	0.11	0.51	0.11	0.50	0.10
C. Officers	387.2	358.9	443.5	420.7	463.2	420.3
n	4.3M		150k		122k	

Notes. The full sample includes all contractual action for 85 civilian contracting offices over 11 years (2000–2010). The second sample is limited to original definitive contracts. The third subsample is further limited to only the original definitive service contracts.

The first set of sample statistics locates original definitive contracts in the constellation of all contractual actions. Definitive contracts make up only 14% of all contractual actions and original contracts make up 39% of contractual actions, overall. About 25% of those definitive contract actions are original contracts, with the rest being various sorts of modification. Of the original definitive contracts, over 80% are service contracts.

The second set of sample statistics describes competition. Overall, 61% of contractual actions are fully and openly competed, while only about 43% of original definitive contracts are. Instead, more original definitive contracts are either competed with exclusions of sources (15%, as compared to 9% overall) and not available for competition (27% in the excluded category, versus 18% overall). Again, services are even less likely to be competed than other definitive contracts. If we think one-off definitive contracts are harder to specify than average, and service contracts especially so, this pattern is consistent with the model.

The third set of sample statistics is pricing form. Overall, 65% of contractual actions have firmly fixed prices, while 85% of original definitive contracts do.

The fourth set of sample statistics presents data on eventual modification. It is defined only for original contracts, since every modification must accrue to one such contract. Among our sample of definitive contracts, substantive modification is very common, with 37% experiencing a substantive modification, and the average contract experiencing 1.33 such modifications. Termination, by contrast, is quite rare, occurring in less than 1% of contracts. Again, services seem more subject to ex-post change, with 43% being modified with an average of 1.54 modifications per original contract.

The final set of contract characteristics are obligations. The definitive contracts are big, with average initial obligation of $850,000 and an average final obligation of $2,410,000. They are nearly three times as large as the average contractual action. Services contracts initially obligated about the same as the average definitive contract, but the difference between initial and final obligations is bigger for them, on average.

Finally, we have a set of office-level characteristics, where offices are weighted by the number of contracts. The average contractual action takes place in an office with 387 contracting officers, while the average original definitive contract is written in a bigger office, with about 444 contracting officers. About 94% of original

definitive contracts are written in office/years that experience at least one retirement, while only 90% of overall contractual actions are. Overall, contracting officers are quite experienced, with the average contract being written in an office in which 25% of officers have 10–20 years of experience and 50% of contracting officers having even more than that.

Table 2 provides another way to look at the data, focusing on the original definitive contract that will make up the analysis subsample. It divides these contracts between fixed-price and variable-price contracts and further sub-divides them into contracts that are eventually modified and those that are never modified in our sample period (it is possible that some of the later contracts will be modified in the future). The first thing to note, all the way at the bottom of the table, is the difference in the degree to which the two pricing types are modified. Consistent with the model, variable-price contracts are modified at a much higher rate than fixed-price contracts. Furthermore, even conditional on modification, they are modified 1.5 more times, on average.

Table 2. Detailed Summary Statistics for Definitive Contracts by Pricing Terms and Eventual Modification

	Variable Price		Fixed Price	
	Never Mod.	Mod.	Never Mod.	Mod
Full and Open Comp.	0.29	0.45	0.46	0.42
	(0.46)	(0.50)	(0.50)	(0.49)
Excl. of Sources	0.044	0.087	0.15	0.20
	(0.21)	(0.28)	(0.36)	(0.40)
Not Comp.	0.18	0.18	0.16	0.11
	(0.39)	(0.38)	(0.36)	(0.31)
Init Oblig ($M2009)	0.54	2.31	0.49	1.24
	(6.03)	(59.7)	(4.41)	(8.42)
Final Oblig ($M2009)	0.69	18.2	0.51	2.36
	(6.40)	(235.6)	(4.50)	(24.4)
Modifications	0	4.74	0	3.26
	(0)	(8.24)	(0)	(8.13)
Pct. 10–20	0.28	0.27	0.26	0.26
	(0.097)	(0.095)	(0.099)	(0.091)
Pct. 20+	0.53	0.52	0.50	0.50
	(0.11)	(0.10)	(0.11)	(0.10)
C. Officers	247.9	229.6	514.1	418.9
	(311.1)	(237.9)	(448.5)	(392.4)
Pct. Retire	0.032	0.032	0.036	0.035
	(0.025)	(0.028)	(0.024)	(0.026)
Any Retire	0.87	0.87	0.95	0.94
	(0.34)	(0.33)	(0.21)	(0.24)
n	11k	11k	82k	44k
Share Modified	49.8		35.2	

Notes. Sample means and standard deviations are in parentheses for original definitive contracts. The sample is divided into by firm-fixed-price contracts and variable-price and further divided between those contracts that are eventually modified and those that are not. Contract-office-level statistics are weighted by the number of original definitive contracts of the appropriate type.

In terms of competition, there are a couple of notable differences across the classes. First the variable-price contracts that are never modified are much less likely to be fully competed, or to be competed with excluded sources, than average. Finally, they are overwhelmingly more likely than the other contract classes to be not available to competition. Compared to the fixed-price contracts, the modified variable-price contracts are about half as likely to be competed with excluded sources and significantly more likely to not be competed at all. Among fixed-price contracts, those that are never modified are slightly more likely to be competed fully,

slightly less likely to be competed with exclusions, and slightly more likely to not be competed at all. They are also slightly less likely to be not available to competition (the excluded category).

For all contract pricing types, the initial and final obligations on never-modified contracts are smaller than those on eventually modified contracts. Obviously, the difference between initial and final obligation is much bigger for modified contracts than for contracts that experienced no substantive modifications, but the obligations only double on average for modified fixed-price contracts, while they increase by about eight times for modified variable-price contracts.

Finally, there does not seem to be much difference between the offices writing the contracts of the various types in terms of experience or retirement rates, but they do seem to differ in overall size. The average fixed-price contract is written in an office with about 450 GS-1102s, and those fixed-price contracts that are never modified are written in the largest offices of all (514 GS-1102s), while the average variable-price contract is written in the an office with about 240 GS-1102s. Variable-price contracts that are eventually modified are written in the smallest offices of all (230 GS-1102s). Again, this pattern is consistent with the model, if we interpret few contracting officers as a measure of workload. Obviously, the offices with more contracting officers are more likely to experience a retirement (about 95% in the fixed-price contracts), but the retirement rates are quite consistent across contract types.

Although the patterns in the sample statistics are intriguing, they are likely to be fraught with omitted variable bias and endogeneity. In the next section, I lay out an econometric strategy for identifying the causal effect of workload on contractual outcomes.

Econometric Specification of Workload

Constructing some consistent measure of workload across agencies and time is a particularly difficult task. The problems of using naive measures such as

contracts per officer or dollars obligated per officer are well documented (Black, 1995; Reed, 2010) and are present here as well. Some contracts are much more complex than others, and simply adding up the number of contracts or dollars would overstate the load on those agencies that have relatively simple tasks to perform and understate the load on those with complex tasks. Since the difficulty of the tasks themselves might also directly influence the structure of the procurement terms, any results derived from such a biased measure of workload would be a priori suspect. Instead of trying to measure work per officer directly, I instead concentrate on the effects of increasing or decreasing the number of contracting officers in an agency, while controlling for the number and mix of purchases that the officers need to manage.

The mix of procurement problems varies enormously across agencies and over time, so some consistent method of measurement must be adduced. Most extant measures use some sort of ex-ante weighting scheme among contracts. The most well known of these is the Air Force manpower standard for operational contracting (AFMS; Air Force Manpower & Innovation Agency [AFIMA], 2001). AFMS counts up contractual actions, giving fixed extra weights to actions with certain characteristics, including actions over $100,000, actions during expeditionary deployments, and certain oversight activities. In all, there are around 200 individually specified weights. No weight is given to modifications or orders off centralized contracts. Other agencies have broadly similar methods of calculating workload (for a detailed summary, see Reed [2010]), but implementing such a method is not feasible in the present study for two reasons. First, any ex-ante weighting system derived without cross-agency measures of time use would be extremely ad hoc. Second, all the extant schemes that could be applied in a cross-agency framework have workload weights that depend on the very outcomes we are interested in exploring: solicitation procedure, dollars obligated, and extent competed. Since those choices are equilibrium outcomes, including them in the workload measure will lead to biased results.

Given the problems with these ex-ante workload weights, I instead take a relatively agnostic approach and try to let the data tell me how work-intensive various contracting actions are. For each agency-year, in every regression, I include (the log of) the number of contracting officers. I categorize each original action according to which of 55 major product/service codes is the primary object of the action. For each product/service class, I count the (log of) the number of original contracts for each agency/year combination and include these as 55 separate controls, indexed by j.[16] Finally, every regression includes measures of contracting-officer experience, including the fraction with 10–20 years of experience and the fraction with over 20 years of experience, agency fixed effects, year fixed effects, and product/service fixed effects.

Intuitively, we want to compare the outcomes for an agency in years when it has more contracting officers than we would predict given its contract load, mix, and experience to that same agency in years when it has fewer officers, all the while adjusting for year-specific factors that are common to all agencies and product/service-specific factors. Formally, I estimate the following fixed-effects OLS (FE-OLS) equation for contract i in product class p in agency s in year t.

$$y_{ipst} = \beta officers_{st} + \gamma' E_{st} + \sum_{j=1}^{55}(\alpha_j X_{jst}) + \gamma_{pst} + \in_{ipst} \quad (1)$$

where employment ($officers$) and contract counts (X) are measured in logs, E is the vector of experience controls, γ_{pst} is the combination of three fixed effects (agency, year, and product class), and y is the outcome of interest. Across various contracting outcomes, our interest is in estimating β, the effect of expanding the contracting workforce on that outcome. Since the variable of interest varies at the agency-year level only, standard errors are clustered at that level.

[16] All the results are robust to also including the number of modifications performed in the office/year as an additional measure of work. I prefer the specification without, however, since I worry that the number of modifications performed may be an intermediate outcome.

Instrumental-Variable Estimation

The approach presented in the previous section has an advantage over a naive regression of outcomes on contracts per GS-1102 because it adjusts for observable predetermined differences in work mix. If the naive measure was biased because offices that handled simple products/services hired fewer GS-1102s per contract, the problem is solved. There can still be a lot of variation in complexity within an agency and product class; this sort of variation would not bias the estimates of β unless the unobservable complexity varies over time within an agency and is correlated with both employment and contractual outcomes.

If there are unobservable changes in complexity that occur *within* agency and product class, and those changes are correlated with contracting officer employment in the agency, the estimates of β are still biased. Imagine, for example, that the mission of the agency changes slightly over time, and it has to write more complicated contracts without any significant change to the product mix. To respond to this increased complexity, the agency may hire more contracting officers and start writing in different contractual terms. In that case, the FE-OLS estimates might find a relationship between contracting officer employment and contractual terms, but that relationship would not be causal. In fact, some third factor (mission complexity) is driving both.

To get around this problem, we need to find some intervening variable that leads to a shift in the employment of contracting officers that is independent of other factors that might affect contractual mix, an instrumental variable. My approach is to use retirements by contracting officers as an instrument for employment.

For this approach to be successful, two conditions must be satisfied. First, variation in contracting-officer retirement rates over time within an agency must have some power in explaining variation in employment. Second, conditional on other covariates, retirement rates must only relate to contractual form due to their correlation with employment. To return to the example, if retirement rates suddenly

jump or fall because of the change in agency mission, this assumption would not be satisfied. Given the structure of the civil service retirement system, retirement seems to be driven, in large part, by the threshold rules that govern pension obligations. Retirement rates spike dramatically as employees qualify for full benefits at certain age thresholds, which depend on their years of service (Asch, Haider, & Zissimopoulos, 2005). As long as this effect is the primary determinant of retirement, the instrument will be valid.[17]

To check the first assumption, that retirement rates are related to employment, I estimate the following regression:

$$officers_{st} = \beta_1 anyretire_{st} + \beta_2 pctretire_{st} + \gamma' E_{st} + \sum_{j=1}^{55} (\alpha_j X_{jst}) + \gamma_{st} + \in_{st}. \quad (2)$$

In this regression, $anyretire_{st}$ is a dummy for whether there are any retirements in agency s in fiscal year t, and $pctretire_{st}$ is the log of the percent of GS-1102s who retire. Since our interest is in using this relationship to explain variation in contract-level outcomes, I weight this first-stage regression by the number of original definitive contracts in each agency-year. Panel A of Table 3 displays the results of these estimations, for the full sample, the big agency subsample, and the services subsample. In all three cases there is a strong and robust relationship between retirements and employment. The joint hypothesis that both retirement variables are equal to zero is rejected with $p < 0.005$.

[17] An alternative approach would be to code age directly, and use the number of contracting officers crossing the retirement age threshold as the instrument. This approach would be even more robust to endogeneity, since surely managers do not plan the age distribution decades in advance in anticipation of change in agency mission. There are two reasons this approach is not feasible with my data. First, the age and experience data are available in bins of five years, so I can only observe how many contracting officers are between 50–54 years old, and I cannot know how many crossed any given year threshold. Second, the age threshold for retirement eligibility is a function of years of experience, and I only observed binned experience and binned age, and not binned age *x* experience. I have tried ignoring these problems and simply using the age bins and lagged age bins as instruments, but the first stage relation with employment is too weak to provide valid IV inference.

Table 3. The Relationship Between Retirements, Employment, and Contracts

	Full Sample	Big Agencies	Services
Panel A (First Stage): Predicting Employment			
Pct. Retire	−0.06***	−0.06***	−0.07***
	(0.01)	(0.01)	(0.01)
Any Retire	−0.16***	−0.13***	−0.21***
	(0.03)	(0.04)	(0.05)
Pct. 10–20	−1.25***	−1.60***	−1.20***
	(0.21)	(0.27)	(0.20)
Pct. 20+	−1.55***	−1.66***	−1.70***
	(0.25)	(0.33)	(0.22)
Joint Test of Retirement Variables			
F-Stat	16.60	13.0	12.20
p-value	0.00	0.00	0.00
Panel B (Exogeneity): Predicting Number of Contracts			
Pct. Retire	−0.06*	−0.06*	−0.03
	(0.03)	(0.03)	(0.04)
Any Retire	−0.11	−0.07	−0.06
	(0.12)	(0.15)	(0.15)
C. Officers	0.31	0.32	0.28
	(0.21)	(0.28)	(0.18)
Pct. 10–20	−0.60	−0.74	−0.39
	(0.53)	(0.71)	(0.45)
Pct. 20+	−1.01	−1.13	−0.60
	(0.75)	(0.97)	(0.51)
Joint Test of Retirement Variables			
F-Stat	2.0	2.2	0.25
p-value	0.14	0.13	0.78
n	828	400	828

Notes. Panel A Dependent Variable: The log of the number of contracting officers. Panel B Dependent Variable: The log of the number of original contracts. The unit of observation is the agency-year, and regressions are weighted by the number of original definitive contracts. In addition to the tabulated regressors, the first stage includes the log of the number of original contracts in 55 product/service groups and the log of the number of modifications in that agency-year, agency fixed effects, and year fixed effects. The second panel does not include contract workload controls. The full sample includes contracts from 85 agencies over 11 years (2000–2010). Standard errors, in parenthesis, are clustered by agency. *,**,*** represent significance at the 0.10, 0.05, and 0.01 levels, respectively.

To investigate the exclusion restriction, I check in Panel B of Table 3 for one obvious sort of reverse causality, that big changes in workload push people to either retire or stay around. To test this, I repeat the estimation in Equation 2, with two differences. I replace the dependent variable with the log of the total number of

contracts in the agency-year and replace the controls for product/service mix with the log of contracting officer employment, as a time-varying measure of size. Since product counts will be collinear with the new dependent variable, they must be dropped, but some measure of scale must be included. In all three samples, retirement rates are only weakly related to the number of contractual actions. Since the regression includes agency and year fixed effects, the retirement rate in years with higher than expected numbers of contractual actions are no different from those with lower than expected numbers. If there is any relationship, it is negative, so people are less likely to retire when the agency is busy. Such a relationship would tend to bias toward finding no effect of workload on contracting, since the endogenous positive shocks to workload would occur when workload is low. Some unobserved change in a qualitative factor of the contracts may still be driving retirements, and thereby undermining the identification, but we cannot detect much for observable factors.

Award Type Selection

As a last step before proceeding to the substantive results, consider whether limiting our attention to definitive contracts may lead to selection bias. Table 4 presents the effect of additional contracting officers on the choice of award type. The first two columns present fixed-effect OLS and IV estimates of the effect of adding additional contracting officers on a dummy variable indicating whether the award is a definitive contract (versus the other two major categories of award: purchase orders and delivery orders). Panel A presents the results for the entire sample of original contracts. Panel B limits results to original contracts in the big agency sub-sample. Panel C limits results to original service contracts. In all three cases, for both OLS and IV there is very little evidence of selection. In the largest point estimates, big agency or service IV estimates, a 10% increase in the number of contracting officers decreases the probability of using a definitive contract by 0.9 of a percentage point. None of the IV estimates are statistically distinguishable from zero. The OLS estimates are even smaller and of the opposite sign, but are statistically significant at times. This is exactly the pattern we would expect, since agencies that have to write

a lot of specialized definitive contracts will require more contracting officers. This bias illustrates the need for an IV approach, more generally.

Table 4. The Effect of Workload on Award Type

	Def-OLS	Def-IV	Purch-OLS	Purch-IV	Del-OLS	Del-IV
Panel A: Full Sample (n = 1.55M)						
C. Officers	0.02*	−0.05	−0.05***	0.17	0.03	−0.12
	(0.01)	(0.06)	(0.02)	(0.10)	(0.02)	(0.10)
Pct. 10–20	−0.01	−0.09	−0.05	0.22	0.06	−0.13
	(0.03)	(0.08)	(0.06)	(0.15)	(0.07)	(0.14)
Pct. 20+	−0.03	−0.14	−0.06	0.31	0.09	−0.17
	(0.04)	(0.12)	(0.07)	(0.20)	(0.08)	(0.20)
Panel B: Big Agencies (n = 1.42M)						
C. Officers	0.00	−0.09	−0.01	0.40**	0.00	−0.31**
	(0.02)	(0.10)	(0.03)	(0.17)	(0.03)	(0.16)
Pct. 10–20	−0.02	−0.18	0.00	0.72**	0.01	−0.54*
	(0.06)	(0.18)	(0.10)	(0.30)	(0.10)	(0.29)
Pct. 20+	−0.04	−0.22	0.02	0.82**	0.02	−0.60*
	(0.07)	(0.20)	(0.08)	(0.33)	(0.10)	(0.31)
Panel C: Services (n = 923k)						
C. Officers	0.04**	−0.09	−0.04**	0.11	0.00	−0.02
	(0.02)	(0.08)	(0.02)	(0.10)	(0.02)	(0.11)
Pct. 10–20	0.01	−0.14	0.02	0.20	−0.03	−0.05
	(0.04)	(0.11)	(0.06)	(0.14)	(0.07)	(0.14)
Pct. 20+	−0.07	−0.28*	0.06	0.31	0.01	−0.03
	(0.05)	(0.15)	(0.06)	(0.19)	(0.08)	(0.19)

Notes. The Dependent variable in all regression is a dummy variable indicating whether the award is of the indicated type (definitive contract for specifications 1 and 2, purchase order for specifications 3 and 4, and delivery order for specifications 5 and 6). Panel A includes all original contractual actions, Panel B limits to the big agency sub-sample, and Panel C limits to services. In addition to the tabulated regressors, each specification includes the log of the number of original contracts in 55 product/service groups, product/service fixed effects, agency fixed effects, and year fixed effects. The full sample includes contracts from 85 agencies over up to nine years (2000–2008). Standard errors, in parenthesis, are clustered by agency-year. *,**,*** represent significance at the 0.10, 0.05, and 0.01 levels, respectively.

The final four columns of Table 4 repeat this analysis for purchase orders (columns 3 and 4) and delivery orders (columns 5 and 6). Here, there is some evidence of substitution between these two types, at least in the case of big agencies. Big agencies with an exogenous positive shock to the number of

contracting officers make greater use of purchase orders and fewer calls on indefinite-delivery contracts. Both of these award types are for relatively simple or standardized purchases, but a purchase order allows the contracting office to specialize the order to their particular needs, but at the cost of additional time of running an individualized procurement (even though it is done under simplified procedures). In contrast, using a delivery order from an extant indefinite delivery vehicle may save time at the cost of not quite fitting the agency's needs perfectly. Given this trade-off, the observed pattern of substitution is very sensible and consistent with the spirit of the model.

To summarize, there is some evidence of substitution among simplified award types as workload changes, but no evidence of substitution between definitive contracts and either of the other two award types. In the analysis that follows, I limit my attention to definite contracts.

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Civilian Results

Degree of Competition

Table 5 outlines the estimated effects of decreasing workload on the decision to award a contract by competitive mechanisms. For all samples, the OLS results would suggest that having more contracting officers is associated with negligible differences in the use of competitive contracting mechanisms. Agencies that have more contracting officers than we would expect, given their mix of contracts, are no more or less likely to use full-and-open competition or to exclude sources.

Table 5. The Effect of Workload on Competition

	OLS	IV	OLS-Big	IV-Big	OLS-Serv	IV-Serv
Panel A: Full and Open Competition						
C. Officers	0.04	0.39**	0.04	0.41**	0.03	0.25
	(0.04)	(0.18)	(0.05)	(0.21)	(0.04)	(0.19)
Pct. 10–20	−0.12	0.34	−0.18	0.41	−0.15	0.11
	(0.10)	(0.25)	(0.14)	(0.35)	(0.11)	(0.24)
Pct. 20+	0.14	0.69**	0.11	0.70**	0.06	0.38
	(0.11)	(0.30)	(0.15)	(0.35)	(0.12)	(0.28)
Panel B: Competition with Exclusion						
C. Officers	0.02	−0.51***	0.03	−0.59***	0.01	−0.37**
	(0.03)	(0.17)	(0.05)	(0.20)	(0.03)	(0.16)
Pct. 10–20	0.18**	−0.49**	0.23*	−0.78**	0.22***	−0.22
	(0.08)	(0.24)	(0.12)	(0.34)	(0.09)	(0.20)
Pct. 20+	−0.16*	−0.97***	−0.21	−1.20***	−0.06	−0.60**
	(0.09)	(0.28)	(0.13)	(0.35)	(0.10)	(0.25)
Panel C: Not Competed						
C. Officers	−0.03	−0.07	−0.01	−0.04	−0.03	−0.06
	(0.03)	(0.12)	(0.03)	(0.13)	(0.03)	(0.14)
Pct. 10–20	0.11	0.06	0.18	0.12	0.15*	0.12
	(0.08)	(0.16)	(0.11)	(0.21)	(0.09)	(0.16)
Pct. 20+	0.12	0.06	0.11	0.06	0.17**	0.14
	(0.09)	(0.20)	(0.12)	(0.22)	(0.09)	(0.20)
n	148,592		139,936		121,013	

Notes. Dependent variable: Indicator of use of given level of competition. Not available for competition is the excluded class. Regressions include original definitive contracts, limited to 39 large agencies in specifications 3 and 4, and to service contracts in specifications 5 and 6. In addition to the tabulated regressors, each specification includes the log of the number of original contracts in 55 product/service groups and the log of the number of modifications in that agency-year, product/service fixed effects, agency fixed effects, and year fixed effects. The full sample includes contracts from 85 agencies over up to 11 years (2000–2010). Standard errors, in parenthesis, are clustered by agency-year. *,**,*** represent significance at the 0.10, 0.05, and 0.01 levels, respectively.

The IV results, however, suggest that these OLS results are likely misleading. When we consider exogenous changes in the number of contracting officers, the results are dramatically different. Increasing the number contracting officers actually increases the use of competitive procurement mechanisms. In particular, increasing the number of contracting officers by 10% increases the probability of full-and-open

competition by about 4 percentage points, decreases the use of competition with excluded sources by about 5 percentage points, and decreases the probability that a contract is not competed at all by about 1 percentage point. To give a sense of magnitudes, about 40% of contracts are fully and openly competed, while about 15% are competed after exclusion. The relationship may be slightly weaker for service contracts, although the difference is not significant.

The most plausible reason for the difference between IV and OLS results is that the FE-OLS approach has not succeeded in controlling for the differences in contract mix within an agency over time. More difficult procurements will both require more officers and will be less likely to be fully competed, and we are seeing this correlation when agencies respond to a change in the mix of procurement problems they face by adjusting their employment of contracting officers. Even if the adjustment is imperfect, the correlation could still move in the observed direction. Only when armed with a shock to employment, such as a spate of retirements, can the true effect of exogenous changes in the number of contracting officers be uncovered.

Having experienced contracting officers seems to have a similar effect as having more contracting officers. A 10% increase in the number of very experienced (20+ years of experience) officers is associated with a 7% increase in the probability of full-and-open competition, with a concomitant reduction in the use of competition with exclusion. This pattern is evidence for the very reasonable idea that more experienced contracting officers may be more efficient in writing contracts and running competitions, perhaps due to the accumulation of specific human capital.

Pricing Structure

Table 6 outlines the estimated effects of decreasing workload on the pricing structure chosen by the contracting officer. For all samples, the OLS results would suggest that having more contracting officers is actually associated with more fixed-

price contracting. Agencies that have more contracting officers than we would expect, given their mix of contracts, are more likely to use firm-fixed-price contracts.

Table 6. The Effect of Workload on Contract Pricing

	OLS	IV	OLS-Big	IV-Big	OLS-Serv	IV-Serv
	Use of Firm Fixed-Price Contracts					
C. Officers	0.07***	0.11	0.13***	0.16*	0.07**	0.05
	(0.03)	(0.09)	(0.03)	(0.10)	(0.03)	(0.09)
Pct. 10–20	0.15*	0.19	0.36***	0.43**	0.10	0.07
	(0.08)	(0.13)	(0.10)	(0.19)	(0.08)	(0.14)
Pct. 20+	0.22***	0.28**	0.41***	0.47***	0.15**	0.12
	(0.07)	(0.14)	(0.09)	(0.17)	(0.08)	(0.14)
n	148,457		139,819		120,958	

Notes. Dependent variable: Indicator of use of firm-fixed-price contract. Regressions include original definitive contracts, limited to 39 large agencies in specifications 3 and 4, and to service contracts in specifications 5 and 6. In addition to the tabulated regressors, each specification includes the log of the number of original contracts in 55 product/service groups and the log of the number of modifications in that agency-year, product/service fixed effects, agency fixed effects, and year fixed effects. The full sample includes contracts from 85 agencies over up to 11 years (2000–2010). Standard errors, in parenthesis, are clustered by agency-year. *,**,*** represent significance at the 0.10, 0.05, and 0.01 levels, respectively.

The IV results, in this case, suggest that these OLS results are approximately correct. When we consider exogenous changes in the number of contracting officers, the results are qualitatively quite similar to the OLS results, for the most part. Increasing the number contracting officers increases the use of fixed-price contracts. In particular, increasing the number of contracting officers by 10%, increases the probability of using a firm-fixed- price contract by about 1 percentage point. On average, about 85% of contracts in the sample are firm-fixed-price contracts. There is little evidence for a difference between IV and OLS results. Perhaps agencies are not as responsive to employment needs that result in changes in pricing terms as they are in responding to employment needs that would result in changes in the use of competitive procurement practices.

Finally, just as in the case of competition, experienced contracting officers affect pricing terms in the same manner as more contracting officers do. An officer

with a more experienced staff of contracting officers uses significantly more firm-fixed-price contracts. Again, this is consistent with experienced officers doing a better job of writing complete contracts.

Obligations

Table 7 outlines the estimated effects of decreasing workload on the initial and final amount obligated on the contract, where final obligations take into account all later adjustments due to modification. The OLS results suggest that having more contracting officers is associated with lower initial and final obligations, on average. The IV results, in this case, again suggest that these OLS results are approximately correct. Increasing the number of contracting officers lowers the initial and final dollar cost of the contract. In particular, increasing the number of contracting officers by 10% lowers the expected final obligation by between 2–4%. The effect on initial obligations is in the same direction and about half to two-thirds the size.

Table 7. The Effect of Workload on Obligations

	OLS	IV	OLS-Big	IV-Big	OLS-Serv	IV-Serv
			Panel A: Total Dollars Obligated			
C. Officers	−0.28***	−0.31	−0.42***	−0.36	−0.19**	−0.22
	(0.08)	(0.35)	(0.11)	(0.38)	(0.08)	(0.35)
Pct. 10–20	−0.39	−0.43	−0.79**	−0.69	−0.60**	−0.64
	(0.24)	(0.52)	(0.33)	(0.71)	(0.25)	(0.48)
Pct. 20+	−0.37	−0.42	−0.68**	−0.59	−0.51**	−0.56
	(0.23)	(0.60)	(0.29)	(0.70)	(0.24)	(0.56)
			Panel B: Initial Dollars Obligated			
C. Officers	−0.14**	−0.26	−0.28***	−0.21	−0.05	−0.15
	(0.07)	(0.29)	(0.09)	(0.32)	(0.06)	(0.28)
Pct. 10–20	−0.09	−0.23	−0.42	−0.30	−0.24	−0.35
	(0.20)	(0.43)	(0.28)	(0.59)	(0.20)	(0.38)
Pct. 20+	−0.01	−0.18	−0.13	−0.02	−0.13	−0.26
	(0.19)	(0.50)	(0.24)	(0.57)	(0.19)	(0.44)
n	148,645		139,979		121,053	

Notes. Dependent variable: The natural log of the cost of obligations, measured in real 2009 dollars. Regressions include original definitive contracts, limited to 39 large agencies in specifications 3 and 4, and to service contracts in specifications 5 and 6. In addition to the tabulated regressors, each

specification includes the log of the number of original contracts in 55 product/service groups and the log of the number of modifications in that agency-year, product/service fixed effects, agency fixed effects, and year fixed effects. The full sample includes contracts from 85 agencies over approximately 11 years (2000–2010). Standard errors, in parenthesis, are clustered by agency-year. *,**,*** represent significance at the 0.10, 0.05, and 0.01 levels, respectively.

This could involve a lot of money. Take the smallest estimate, with an elasticity of about −0.2. Weighting by contracts, the average agency has about 444 contracting officers and handled about 1,765 original definitive contracts over the sample period with an average final obligation of about $2.41 million in 2009 dollars. If they had increased their workforce to 488 officers, the total obligations would have fallen to about $2.36 million per contract, a savings of about $88.2 million over the 11-year period. A rough estimate of $150,000 per contracting officer per year implies a net savings of about $15.5 million dollars per agency on original definitive contracts. Note, this calculation excludes any concomitant effects on obligations for other contract types, but I have no reason to suspect they would move in the opposite direction.

Once again, more experienced officers have a similar relationship to contracting outcomes as having more contracting officers. Offices with more experienced contracting officers obligated less money, overall, although the relationship is only statistically significant in the case of the OLS estimates in big agencies.

Modifications

Table 8 outlines the estimated effects of decreasing workload on the presence and number of substantive modifications or terminations. For this analysis only, I limit the sample to contracts written before 2009, since enough time must pass to observe any modifications. For all three samples, the OLS results would suggest that having more contracting officers is not robustly associated with ex-post changes, or else that the effect is very small.

Table 8. The Effect of Workload on Substantive Modifications

	OLS	IV	OLS-Big	IV-Big	OLS-Serv	IV-Serv
Panel A: Any Substantive Modifications						
C. Officers	−0.02	−0.12	0.03	−0.07	−0.06*	−0.24*
	(0.03)	(0.14)	(0.04)	(0.18)	(0.03)	(0.13)
Pct. 10–20	−0.20**	−0.30*	−0.12	−0.27	−0.21*	−0.38**
	(0.10)	(0.18)	(0.15)	(0.28)	(0.11)	(0.17)
Pct. 20+	−0.16	−0.28	−0.09	−0.22	−0.20*	−0.40**
	(0.10)	(0.20)	(0.13)	(0.25)	(0.11)	(0.19)
Panel B: Termination						
C. Officers	−0.00	−0.04**	−0.01*	−0.04*	−0.00	−0.04**
	(0.00)	(0.02)	(0.00)	(0.02)	(0.00)	(0.02)
Pct. 10–20	−0.03**	−0.06***	−0.04***	−0.08**	−0.03***	−0.07***
	(0.01)	(0.03)	(0.02)	(0.04)	(0.01)	(0.03)
Pct. 20+	−0.01	−0.05**	−0.03***	−0.06**	−0.02	−0.06**
	(0.01)	(0.02)	(0.01)	(0.03)	(0.01)	(0.02)
Panel C: Number of Substantive Modifications						
C. Officers	−0.05	−0.23	0.00	−0.17	−0.09**	−0.37*
	(0.04)	(0.21)	(0.06)	(0.27)	(0.05)	(0.21)
Pct. 10–20	−0.23	−0.43*	−0.18	−0.42	−0.24	−0.50*
	(0.15)	(0.26)	(0.22)	(0.42)	(0.17)	(0.26)
Pct. 20+	−0.01	−0.24	0.07	−0.14	0.01	−0.29
	(0.14)	(0.29)	(0.18)	(0.37)	(0.16)	(0.28)
n	117,351		110,860		95,571	

Notes. Panel A Dependent Variable: Indicator of a subsequent substantive modification. Panel B Dependent Variable: Indicator of a contractual termination. Panel C Dependent Variable: the log of one plus the number of substantive modifications. Regressions include original definitive contracts, limited to 39 large agencies in specifications 3 and 4, and to service contracts in specifications 5 and 6. In addition to the tabulated regressors, each specification includes the log of the number of original contracts in 55 product/service groups and the log of the number of modifications in that agency-year, product/service fixed effects, agency fixed effects, and year fixed effects. The full sample includes contracts from 85 agencies over up to nine years (2000–2008). Standard errors, in parenthesis, are clustered by agency-year. *,**,*** represent significance at the 0.10, 0.05, and 0.01 levels, respectively.

Table 9. Average Total Contract Load, GS-1102 Employment, and Initial Obligation ($2009) for Big Agencies

Agency	GS-1102s	Avg. Obligation ($M2009)	Contracts
Dept of VA	1001.2	0.46	39692
FSS + FTS (Joint)	761.7	0.37	966
NASA	724.0	0.62	7859
Fed. Supply Serv. (Pre-Merger)	588.2	0.25	914
Public Building Serv.	574.8	1.50	9946
Dept of Energy	518.6	4.56	2080
Bureau of Prisons	328.0	1.93	2799
NIH	322.3	1.48	3517
Coast Guard	303.9	0.63	3849
IRS	284.6	0.44	729
Forest Service	274.8	0.24	14410
National Park Service	214.6	0.66	5128
Fed. Tech Service (Pre-Merger)	181.6	0.97	1345
State Dept.	133.9	2.13	5787
US Customs Service	120.8	1.30	538
Interior- OPMB	117.5	0.55	2374
FEMA	99.8	4.21	557
Bureau of Reclamation	92.9	1.00	1210
HUD	92.5	1.43	1511
Social Sec. Admin.	92.5	0.79	542
NOAA	92.4	0.62	2289
CDC	89.6	2.58	1878
Natural Res. Conserv. Serv.	86.9	0.40	1228
Bureau of Land Management	72.2	0.33	2197
Fish and Wildlife	70.1	0.39	2147
FBI	69.6	0.86	1066
Dept of Educatioj	59.6	1.50	533
Farm Service Agency	59.1	1.00	8536
Ag. Research Serv.	56.4	0.69	1192
Indian Affairs	54.2	0.64	1263
Geological Survey	53.7	0.33	631
FDA	53.6	0.41	950
”DOJ-Offices, Boards, and Div.”	40.3	0.29	6116
Minerals Management Serv.	37.3	0.60	568
Fed. Highway Admin	35.7	3.42	1192
NIST	30.5	1.09	616
Labor- ETA	23.7	2.34	661
OPM	17.7	1.17	710
Surface Mining and Reclamation	8.02	0.13	799

Notes. Agencies with at least 500 original definitive contracts. GS-1102 is the average stock of contracting officers at the start of the fiscal year. Contracts is the total number of original definitive contracts in the sample. Obligation is the average obligation for original definitive contracts.

The IV results, by contrast, show significant effects of workload on contract terminations in all three samples. Increasing the number of contracting officers by about 10% when the original contract is signed decreases the probability that the contract is later terminated by about 0.4 percentage points, on a mean of less than 1%.

The IV results for modifications are more mixed. For service contracts, having more contracting officers leads to fewer modification, along both the extensive and intensive margins. Specifically, increasing the number of contracting officers by 10%, decreases the probability of modification by about 2.5 percentage points, and decreases the expected number of modifications by about 3.7%. To judge the size of these effects, about 43% of service contracts in the sample are modified at some point, and the average service contract has about 1.5 modifications. The sign of the IV estimates in the other subsamples is also negative, but these estimates are not statistically different from zero.

Consistent with the predictions of the model, less busy agencies do a better job at foreseeing contingencies in the original contract and, thereby, limiting the need for ex-post renegotiation or termination. This relationship is particularly apparent in the case of service contracts, for which the costs of contractual completeness may be particularly high.

In this final contractual characteristic, we again see the pattern of experience affecting outcomes in the same way that additional staff does. An agency with more experienced contracting officers writes contracts that are less likely to be modified or terminated.

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Summary of Civilian Analysis

This section of the paper explored one driver of incomplete contracting, workload, and the numerous effects of incomplete contracting on other contracting and procurement provisions. As workload increases, contracting officers will optimally write less complete contracts. Recognizing that renegotiation is more likely with less complete contracts, they will also alter the method of competition and pricing structure. In particular, they will lean away from full-and-open competition and away from firm-fixed-price contracts. They will also end up obligating more money, in expectation.

Although this is not the first paper to identify similar effects of contractual incompleteness on contracting and procurement terms, it is unique in its scope and method of identification. Most papers have focused on a single industry and identified variations in completeness by looking for differences in underlying complexity. I, instead, control for complexity and industry, and look at variation in completeness induced by exogenous differences in contracting-officer workload. Despite this very different approach, my results are quite consistent with the literature. This consistency is important, since the potential biases are very different in the two approaches. For the extant literature, researchers worry that complexity may have impacts on contractual forms that are not mediated by incompleteness; for this paper, we worry that workload may have impacts of contractual form that are not mediated by incompleteness. But unless these biases are coincidentally in the same direction for each contractual term, in both approaches, the consistent findings should make us feel more confident about both.

Although a lot is known about the determination of contractual forms, in general, very little work has looked into the effects of workload. Given the dramatic changes in the amount of contracting the federal government has done over the last decade, and the relatively small change in the contracting workforce, understanding these effects is a pressing policy question. In this paper, we have seen that an

incomplete contracting framework is a useful way to thinking about the effects of workload. Furthermore, we quantified some of the benefits of increasing the number of contracting officers (decreasing workload).

These results are relevant beyond their importance for procurement policy. In a private firm, we would probably expect that contracting managers are aware of the trade-off identified here and choose the size of the contracting to maximize expected profits. But experienced contracting officers are probably a fixed resource in the short run, so we might expect there to be important short-run consequences of unexpected shocks to contracting workload. If the economic forces identified here apply in that circumstance too, then firms should respond to sudden increases in procurement needs by increasing their reliance on cost-plus and negotiated contracts, in the short run. Of course, over time they will appropriately re-balance their contracting workforce.

Introduction

Defense contracting is characterized by a high level of uncertainty due to unpredictable changes in both technology and demand. Writing and managing well-specified contracts in this uncertain environment is necessarily time consuming; contracting officers must allocate their limited time-budget among the contracting tasks at hand. If contracting officers' responsibilities expand to include additional tasks, then they must decrease the average amount of time spent on each task, constraining them to leave some potential eventualities unaddressed. In this paper, we investigate how changes in the workload of contracting officers relate to the equilibrium level of contractual completeness and the use of other procurement terms including award type, pricing structure, the use of competition, the probability of renegotiation, and the final price paid.

After briefly outlining the procurement process in the Department of Defense (DoD), we review a model from the section titled Modeling the Procurement Process that extends Bajari and Tadelis (2001) to understand how varying workload affects the choice of contractual completeness and contractual terms. This model predicts that busier contracting officers write less-complete contracts, so the risk of renegotiation increases as fewer contingencies are fully specified. The increased need for contract modifications raises the cost of fixed-price contracts, so higher workload causes contracting officers to shift to more flexible cost-plus contracts. The higher risk of renegotiation also means that the benefit of competitive acquisitions falls because competition only identifies the most efficient contractor for the original contract specification. As a result, the model predicts that busier contractors shift to less competitive acquisitions procedures. All of these individual effects of higher workload—higher risk of renegotiation, reduced use of fixed-price contracts, and

reduced use of competitive acquisitions procedures—increase the expected price of any given project.

In line with this model, we analyze a sample of 4.6 million contracts from a panel of 32 DoD procurement offices over the years 2005–2010. Consistent with the model, we find that exogenous increases in contracting officer workload that increase the cost of contractual completeness decrease the use of competition, increase the probability of renegotiation, and increase the total costs of procurement. Curiously, we find that higher workload increases the use of firm-fixed-price contracts. In addition, we find that higher workloads induce contracting officers to use more delivery orders (calls on an existing contract) and fewer new definitive contracts.

One subset of procurement that has received a lot of attention in recent years is contingency operations in Iraq and Afghanistan. The congressionally appointed Commission on Wartime Contracting in Iraq and Afghanistan (CWC; 2011) estimates that between $31 billion and $60 billion were lost to waste and fraud in Iraq and Afghanistan. In their report on wartime contracting, the CWC (2011) attributes part of this waste and fraud to an insufficient number of acquisitions personnel, stating, “agencies continue to lack sufficient staff and resources to enable adequate management of all aspects of contingency contracting. (p. 11)” In light of these concerns, we separately examine the impact of changing workloads on a subsample of contracts procured in Iraq and Afghanistan. We find that higher workloads do have important implications for the procurement terms of these contingency contracts, but the effects on contingency contracts are not dissimilar to the effects of increased workload on the remainder of (non-contingency) contracts. In fact, with the exception of competition, changes in workload have a lesser effect on the procurements terms for contracts performed in Iraq and Afghanistan than they do for other contracts. Hence, the personnel problems for Iraq and Afghanistan contracts identified by the CWC may be even more important for the domestic procurement policy of the DoD.

The acquisitions community has expressed concern about the growth of contracting straining the capacity of the acquisitions workforce. The DoD's procurement obligations have increased from $270.7 billion in FY2005 to $367.7 billion in FY2010, a 36% increase over these six years (FPDS, 2011). In contrast, the DoD's contracting workforce grew from 26,025 in FY2005 to 29,792 in FY2010—an increase of only 14% over the same six-year period (USD, AT&L, 2010) Moreover, relative to the DoD civilian workforce as a whole, the civilian acquisitions workforce has a disproportionate share of employees near or at full retirement eligibility.[18]

The acquisitions community worries that the increasingly strained contracting workforce will be unable to adequately specify and manage contracts, leading to increased susceptibility to fraud, reduced bargaining power in negotiations, and excessive dependence on private contractors. Rau and Stambersky (2009) report that less than 15% of surveyed senior contracting officers at the Army Contracting Command believed that there were sufficient acquisition management positions in their installation, and only 23% believed that contractor performance on service contracts received the proper level of oversight. Chapter 5 of the Report of the Acquisition Advisory Panel to the Office of Federal Procurement Policy and the United States Congress (Acquisition Advisory Panel, 2007) reports that "inadequacy in the acquisition workforce" wastes government resources and produces unsatisfactory contractual outcomes.[19] We address these concerns in this paper and provide evidence for the consequences of limited contracting capacity on acquisitions outcomes.

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[18] See Gates et al. (2008) for a complete analysis of these trends in the Department of Defense acquisitions workforce.

[19] See also the large body of work by the GAO: *High-Risk Series: An Update* (2005a); *DoD Acquisitions: Contracting for Better Outcomes* (2006c); *Contract Management: DoD Vulnerabilities to Contracting Fraud, Waste and Abuse* (2006b); *Defense Acquisitions: Assessments of Selected Major Weapon Programs* (2006a); *Defense Acquisitions: DoD Has Paid Billions in Award and Incentive Fees Regardless of Acquisition Outcomes* (2005c); *Defense Management: DoD Needs to Demonstrate that Performance-Based Logistics Contracts are Achieving Expected Benefits* (2005b).

We follow the approach introduced above, in the civilian analysis, by taking advantage of variation in the workload of contracting officers as a shifter of the cost of contractual completeness to estimate the relationship between contract specificity and the selection of contractual terms. Our results are generally consistent with those results as well as the broader literature.

In the rest of this section, we put the paper in context, both in terms of the existing literature and the policy environment. In the section A Review of the Procurement Model, we briefly review the model from the civilian analysis that predicts the effects of workload on contractual completeness and procurement terms. In the section DoD Data and Methodology, we discuss the data and the empirical approach. In the section DoD Results, we present the empirical results, and in the section Summary of DoD Analysis and Conclusion, we conclude our analysis.

The DoD Procurement Process

The DoD's basic procurement process progresses in three stages. The process begins with the recognition of an agency need and the development of a procurement strategy intended to meet the need. It continues with the solicitation and award stage, and ends with the contract management and closeout stage.[20] In highly uncertain environments, the DoD uses a modified version of this basic procurement process. We characterize the basic three-stage procurement process in this section and describe two common modifications of this process in the section "Complex Contracting Environments."

In the first stage, the agency determines that is has a need for a product (or service) that it cannot or does not wish to produce with "in-house" resources. A contracting officer employed with the agency then determines the optimal strategy

[20] Adapted from *Contracting Officers Technical Representative (COTR) Training Blueprint* (Federal Acquisition Institute, Office of Governmentwide Policy, & General Services Administration, 2003, pp. 27–30).

for successfully procuring the desired product within the constraints of authorizing legislation, current market conditions, and the requirements of both the Federal Acquisition Regulation (FAR, 2012) and the Defense Federal Acquisition Regulation Supplement (DFARS, 2010). The agency must decide whether and how to compete the contract, the preferred pricing terms, and whether the contract will be for a definitive quantity or some indefinite delivery vehicle.

After the agency determines the method of procurement and contractual form, it solicits bids from potential suppliers. The agency uses various means, including the Federal Business Opportunities website, to request bids from potential contractors,. The request for bids includes a description of the product or service the agency wishes to purchase, the contractors that are allowed to submit an offer, the form that these offers should take, and how the agency intends to evaluate the offers. As dictated by the agency's solicitation, contractors may respond with a simple price bid, a more complicated proposal, or even engage in bilateral or multilateral negotiations with the agency that include exchanges of proposals. The agency evaluates these proposals according to the provisions in the solicitation and an award is made.

Once the contract is awarded, production begins, and the agency begins the contract management stage. The agency oversees production, inspecting for quality, adherence to specifications, and auditing costs when appropriate. If unforeseen contingencies arise during production, the agency may choose to modify the original contract. These modifications may take the form of simple unilateral changes to the specifications or, in the case of significant changes, may require bilateral negotiations to determine an equitable adjustment of pricing. Finally, the contract is ended, either because the contract terms were fulfilled or because the agency terminated the contract for one of many possible reasons, including convenience or contractor default.

Complex Contracting Environments

When the procurement environment is particularly complex, the DoD uses a modified form of the procurement process described in the previous section. There are two main forms this advanced process can take: multi-stage procurements and umbrella contracts.

For complex items with large economies of scale, such as weapons systems, the DoD typically uses multi-stage procurements that repeat the basic procurement process described previously in each stage. The following discussion of multiple-stage contracts is adapted largely from Rogerson (1995) who describes three procurement phases in a product life cycle. The first stage is a design stage in which the agency awards cost-plus contracts to several firms who research and develop competing designs. The design stage has the most competition of the three stages, because, even though uncertainty about the final product is high, economies of scale are relatively low and the competition in research and development enables the agency to identify the best design. At the end of the design phase, the agency selects the two best designs to continue to the sole-source selection phase.

In the sole-source selection stage, the remaining two firms build prototypes, present final design plans, and submit bids for the initial production. Because relatively small quantities of most weapons systems are ever purchased, it is usually unprofitable for more than one firm to produce a particular weapon system. Therefore, at the conclusion of this stage, this agency will generally award production rights to only one firm.

The final phase of weapons procurement is the production stage. Even at this stage, large uncertainties persist because of the probable changes in both technology and the DoD's demand for the product, making long-term fixed-price production contracts impractical. Instead, the DoD typically relies on repeated fixed-price contracts that are signed for one year of production at a time. Because of the large economies of scale, these contracts are almost always negotiated in a sole-source environment, preventing competitive determination of prices. As a result, the

government typically bases prices for these production contracts on historical and projected costs with the inclusion of a “profit” term. Moreover, the Truth in Negotiations Act (TINA, 1962, § 2306a) requires contractors to submit “current accurate and complete” cost estimates during negotiations of the contracted price. The combination of cost-based pricing and TINA means that small cost savings will only benefit contractors for one year before the cost savings are priced into the next contract, and unprecedentedly large cost savings may open the contractor up to prosecution for hiding information and require them to refund these savings back to the DoD. In this environment, fixed-price contracts may not have any advantage over cost-plus contracts: The contractor has little incentive to provide cost-saving effort, and high uncertainty makes renegotiation likely.

The second major modified procurement form is the use of umbrella contracts. When an agency knows it will need a large quantity of some relatively standardized service or product, but the quantity is unknown, the agency may choose to write an indefinite delivery vehicle (IDV) which specifies basic information about the desired good or service. The IDV then acts as a framework for future contracts. When the agency determines it needs the product or service, it makes a “call” on the corresponding IDV, filling in the incremental details such as time, place, and manner of delivery. Agencies can make repeated calls on the same IDV. The advantage of an IDV is the ability to shortcut several stages in the procurement process; contracting officers do not have to re-specify and award the contract repeatedly for the same service. However, the IDV may not be well-specified for every circumstance that generates a call on it, potentially creating the need for costly modifications. One prominent example of an IDV is the Logistics Civil Augmentation Program (LOGCAP) providing broad logistics support to the U.S. Army, including delivery of food supplies, postal services, and facilities maintenance. The most recent iteration, LOGCAP IV, was awarded in 2007 to three firms with a maximum value to each company of $5 billion annually for up to 10 years.

Contracting Officers

The primary DoD agents responsible for overseeing this procurement process are civil service employees in the occupational series GS-1102, generally referred to as contracting officers. The Position Classification Standard for the Contracting Series (OPM, 1983) describes their role as follows:

> This series includes positions that manage, supervise, perform, or develop policies and procedures for professional work involving the procurement of supplies, services, construction, or research and development using formal advertising or negotiation procedures; the evaluation of contract price proposals; and the administration or termination and close out of contracts. The work requires knowledge of the legislation, regulations, and methods used in contracting; and knowledge of business and industry practices, sources of supply, cost factors, and requirements characteristics.

There are a number of military and civilian support personnel that aid these contracting officers in the procurement process, including purchasing officers (GS-1105s, who concentrate on simplified acquisitions), procurement clerical and assistance series employees (GS-1106s, who provide clerical support), and contracting officer representatives and contracting officer technical representatives (various series who develop the contracts' technical requirements and determine if a contractor meets them). We use only ceteris paribus variation in the number of the civilian (GS-1102) contracting officers to measure changes in workload.

In the next section, we describe a model of the procurement that trace the effects of workload shock on procurement and contracting outcomes.

A Review of the Procurement Model

This section's predictions about the effect of workload on contractual completeness and procurement terms are derived from the model from the civilian analysis that extends the analysis in Bajari and Tadelis (2001) of the choice between fixed-price and cost-plus contracts to also include the choice between competition and negotiation. We repeat the basic results here for the reader interested only in the DoD.

In our model of the procurement process, the primary agent is a contracting officer who maximizes a utility function that depends on three elements: the value of the product or service, net of payments to the contractor; the cost of specifying contractual contingencies; and the cost of running a procurement competition.[21] The contracting officer chooses three variable characteristics of the contract: the level of contractual completeness, the pricing terms of the contract (i.e., fixed-price or cost-plus), and whether to run an open competition or to engage in negotiations with a single firm.

The value the contracting officer places on the product to be procured is exogenous and not affected by contracting terms. The final payment is dependent on the initial obligation, pricing terms, and the probability of renegotiation. The contracting officer has a choice of specifying a level of contractual completeness to cover potential contingencies: higher levels of contractual completeness reduce the probability that the contracting officer will have to engage in post-award renegotiations for off-contract performance. The contracting officer bears an exogenously given level of workload on other projects. When his workload increases, his opportunity cost of more fully specifying the current contract also increases.

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[21] The contracting officer need not value the product or its price at the same rate as his political principal for the comparative statics to hold. All that is required is that he would prefer paying less to paying more, all else being equal.

In the event that a contract requires modification after production has started, the contracting officer faces two potential increases in cost. First, modifications should increase production costs on average since some costs are likely to be nonrecoverable. Second, if the contracting officer chooses to award a fixed-price contract, then he must specify a modified contract and negotiate a new payment for this modified contract. We assume that the contracting officer must bear a friction cost associated with this respecification and renegotiation of a fixed-price contract.[22]

The primary purpose of this model is to predict the impact of an exogenous shift in the cost of contractual completeness induced by a change in the contracting officer's workload. An increase in a contracting officer's workload increases the marginal cost of completeness, necessarily reducing the equilibrium level of contractual completeness. This reduction of the optimal completeness will have important effects on the contracting officer's other equilibrium choices as well as his final financial outlay.

Consider first, contracting officers choice between fixed-price and cost-plus contracts. The advantage of a fixed-price contract is the incentive it creates for contractors to efficiently provide non-contractible cost-reducing effort, since the contractor is the residual claimant on any cost savings. In contrast, cost-plus contracts do not produce incentives for cost-saving effort, since any reduction in costs will result in an equal reduction in payment to the contractor. Since the contractor and contracting officer anticipate this cost-saving effort, the initial obligation under a fixed-price contract will be lower than with a cost-plus contract. The advantage of cost-plus contracts is the ease of renegotiation when unspecified contingencies arise. Rather than negotiating a new price for a modified contract, the contracting officer only needs to compensate the contractor for additional costs according to the terms of the original contract. If a contract were fully specified so that there would be no possibility of modification, the contracting officer would

[22] In contrast, these frictions of renegotiation are completely avoidable with cost-plus contracts.

always prefer a fixed-price contract. However, as increasing workload induces the contracting officer to specify less and less of the contract, the ease of renegotiation from cost-plus contracts becomes more attractive. At some threshold of incompleteness, cost-plus contracts may become optimal.

Compare, next, the contracting officer's choice between open competition and single-source negotiation. The advantage of competition is the ability to select an ex-ante more efficient contractor. However, the advantage of competition disappears when modification is certain, since the ex-ante more efficient contractor may not have the lowest costs on the modified contract. The advantage of negotiation is the convenience to forgo the time and expense of conducting an open competitive procurement. As contracts become less and less complete, the benefits of competition diminish without any decline in the cost of running a competition (if anything, the time cost has increased). Hence, a higher workload that reduces completeness will make single-source negotiations more appealing.

Combining these results, we see that an exogenous increase in workload will induce the contracting officer to choose to write a less complete contract and increase his use of cost-plus contracts and single-source negotiations. These choices have important ramifications for both the initial contracted obligation and the final outlays. The initial price is affected by both the pricing terms and the extent the contract is competed. As completeness falls, the increased use of cost-plus contracts will result in fewer cost-saving efforts and the increased use of negotiation will reduce the probability that the contracting officer will select the ex-ante most efficient contractor. Both of these effects will tend to increase the initial contracted price.

The final outlay depends on the initial price and the probability of renegotiation. In the absence of any modification, the final outlay approximately equals the initial price, but reduced contractual completeness increases the probability that the contract will need to be modified. Since some costs are non-recoverable, a modification generates higher total costs on average, again leading to

higher final outlays. Finally, the higher probability of modification means that even when the contracting officer still prefers to use a fixed-price contract, he has a higher probability of having to bear the cost of renegotiation frictions, increasing the expected final outlays. In summary, an exogenous increase in workload which decreases the equilibrium level of completeness increases the expected final outlays due to a higher initial price, reduced cost-saving efforts from increased used of cost-plus contracts, and increased probability of renegotiation which increases both expected production costs and expected contracting costs.

In the empirical analysis presented in the next section, we investigate and find evidence for the predicted effects of increased workload on the use of competition, the probability of renegotiation, initial obligations, and final outlays. The results on pricing terms conflict with the model.

DoD Data and Methodology

We use a large public database of government contracts to build measures of workload and contractual/procurement terms. The contract data consist of every nonclassified transaction from FY2005 to FY2010 above a reporting threshold of $3,000[23] for 32 DoD contracting offices, about 6.9 million actions in all.[24] Gathered from the Federal Procurement Data System (FPDS-NG), through www.usaspending.gov, the contract data include procurement contract transactions reported directly through the contract-writing systems of the constituent agencies. Each initial government obligation appears exactly once (4.6 million), as does every modification of a reported contract (2.3 million). For each contract, the FPDS-NG reports a broad range of information about the contracting parties, the contractual terms, the method of procurement, and the place of performance. The particular provisions that form the basis for the analysis are discussed in detail in the following analysis.

We measure the number of contracting officers in an agency by counting the number of GS-1102s. The data on GS-1102 employment in each contracting agency in each fiscal year comes from the Office of Personnel Management's Central Personnel Data File. It reports the number of civilian contracting officers in each agency at the end of each fiscal year by years of experience in that agency.

Unfortunately, analysis of contracting in defense agencies has several complications that are not present for a similar analysis of civilian agencies. First, compared to civilian agencies, a larger share of defense contracts are classified for reasons of national security and are thus unreported. This missing-data issue has

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[23] Original contracts below the $3,000 reporting threshold are known as "micropurchases," and are exempted from a number of competition and reporting requirements. We drop all reported original contracts below this threshold, because reporting rates of micropurchases may adjust with workload.

[24] This consists of every DoD agency/sub-agency that reports non-zero GS-1102s to the OPM and more than 300 original definitive contractual actions to the FPDS-NG, with a few exceptions. See Table 9 for the list of agencies included in our sample.

two implications for our analysis. First, we can only estimate effects for non-classified contracts and can say nothing concrete about whether these effects would also hold for classified contracts. Second, when estimating workload, we can only imperfectly control for the work on classified contracts. Contract counts for these classified contracts are not available, nor is budgetary information at the agency level. Instead, we control for the fraction of the branch procurement budget that is classified (from the OMB analysis of the DoD budget), where Army, Navy, and Air Force agencies are assigned the fraction for their branch, and non-branch agencies are assigned the fraction classified of the non-branch DoD budget.[25]

Second, procurement work in some defense agencies is shared with career military officers, but the Central Personnel Data File includes only civilian contracting officers. The only publicly available data we can find on this question is available at the branch level at a single point of time (OUSD AT&L, 2010). Since our regression will include agency fixed effects, a control like that would be dropped.

Finally, the contracts data from the FPDS-NG and the employment data from the Central Personnel Data File are reported at different levels within the DoD's hierarchy. At the highest level, the DoD is divided into branches (e.g., Navy). These branches are subdivided into agencies (e.g., Naval Air Systems Command). Each of these agencies can be further subdivided into individual contracting offices. The FPDS-NG reports both the branch and the six-digit DoD Activity Address Code (DoDAAC) of the contracting office that issues each contract but not the agency to which the contracting office belongs. The Central Personnel Data File reports employment of contracting officers only at the levels of the branch and the agency. To match the contracts to the appropriate employment information, we use the Defense Automatic Addressing System Inquiry System[26] (DAASINQ) to identify the agency to which each contracting office belongs. For example, the FPDS-NG reports

[25] The appropriate data are available from the Defense Manpower Data Center, we believe, but they are not publicly available, and we have not been able to gain access to them.

[26] Found online at https://www.daas.dla.mil/daasinq/

contracts from a contracting office with DoDAAC N65886 in the Navy. According to DAASINQ, N65886 is the DoDAAC of the Fleet Readiness Center Southeast which belongs to the agency Naval Air Systems Command (NAVAIR). Consequently, we assign all contracts with DoDAAC N65886 to NAVAIR. We repeat this process for all contracts in the Navy, Army, and Air Force.[27] Table 10 lists additional details about these corresponding agencies, including their distribution of contracts, number of contracts in Iraq or Afghanistan, and number of contracting officers.

[27] FPDS-NG reports the agency instead of the branch for contracts issued by all independent DoD agencies (e.g., the Defense Contract Management Agency).

Table 10. Agencies in DoD Sample

Agency Name	Pct. Purch	Pct. Deliv.	Pct. Def.	I or A	Contracts	C. Off.
U.S. AF, EU	48.2	48.9	2.9	11	22,809	55
Air Ed. and Training	39.2	57.2	3.6	106	46,169	350
HW, Air Force Res.	30.5	61.1	8.4	0	6,776	102
PacAir	35.4	62.0	2.6	0	22,805	93
Air Combat	38.2	57.0	4.8	0	33,456	298
AF Materiel	32.1	58.7	9.2	357	157,565	2455
Space Command	24.8	68.4	6.8	0	19,139	540
Air Force, Wash.	27.4	65.7	6.9	4	6,678	60
ACA	39.7	55.4	4.8	391	285,409	1351
Army Acq. Support	66.3	15.8	17.9	43,775	43,776	256
Army Corps of Eng.	32.7	61.7	5.7	1,704	107,935	846
Army Medical	56.5	41.2	2.3	1	36,008	244
Army National Guard	41.0	56.3	2.7	1	95,487	263
Space and Missile Def.	15.3	58.7	26.0	4	3,106	60
Army Tank-Automotive	36.1	54.1	9.9	12	50,487	776
Army J Munitions	36.9	56.3	6.8	38	4,489	242
DISA	19.9	79.5	0.7	102	49,382	254
DLA	25.3	74.0	0.7	204	2,729,894	2564
DARPA	12.2	23.6	64.2	0	1,166	12
Wash HQ Serv.	19.2	67.6	13.2	3	5,458	36
MDA	5.8	40.6	53.6	0	1,952	111
Defense Commiss.	3.0	96.3	0.7	0	52,826	95
DTRA	26.9	59.5	13.7	0	2,912	67
ONR	57.5	31.3	11.2	1	23,460	109
Naval Med.	48.9	50.2	0.9	0	63,631	105
NavAir	33.7	54.9	11.3	6	39,757	539
NavSup	50.3	45.4	4.4	10	281,770	576
NavSea	46.4	49.9	3.7	6	88,467	515
Naval Fac. Eng.	8.8	85.1	6.1	6	100,438	899
Marine Corps	42.7	55.1	2.2	49	82,320	252
S&N Warfare	29.4	68.5	2.1	150	89,056	201
Atlantic Fleet	21.4	71.7	6.9	0	11,694	85

Contractual Types and Terms

Contractual characteristics vary immensely, even within a single agency. These contract characteristics can be divided into two main subsets: features over which contracting officers have little discretion and features over which contracting officers have more discretion. For example, contracting officers have little discretion over contract features such as product class, as these features are primarily

determined by the nature of the good or service the agency wishes to acquire. Consequently, we primarily take these non-discretionary characteristics as exogenously given, and ignore the possibility that the agency will adjust these features on the margin when workloads change. There is one aspect of the contract, award type, over which the contracting officer may have limited discretion at the margin. For most of the analysis, we will treat award type as given, and return at the end to the question of substitution among award types. Finally, contracting officers have a great deal of discretion over other contracting features such as the nature of competition and pricing terms. When contracting officers' workloads change, we look for adjustments in the mix of these "discretionary" features. Specifically, we analyze the effects of workload on four aspects of contracts: competition, pricing terms, modification, and outlays.

Contracts differ first according to the product or service the agency is procuring. The General Services Administration classifies every product or service purchased by the U.S. federal government as one of 24 broad service classes or one of 90 broad product classes.[28] The FPDS-NG reports the primary product/service class of every contract. Some of these classes, such as Nuclear Ordinance, are not represented or are very small, so we merge them with neighboring categories. After these combinations, there are 55 broad product/service categories.[29]

Second, contracts differ according to the award type. Awards are first categorized by whether the contract specifies a fixed quantity (definitive contract) or not (indefinite delivery vehicle). Awards can also be categorized by whether they are original (i.e., new) contractual actions or modifications to existing contracts. For this paper, the unit of observation is the original contract. We do not consider the effect of workload on the contractual terms of modifications, because the terms of a

[28] For definitions, see Federal Procurement Data System Product and Service Codes Manual (GSA, 2011)

[29] Details of matches are available by request.

modified contract depend in part on the terms specified in the original contract. Consequently, it is unclear whether the workload at the time of the original contract or the workload at the time of the modification should affect the terms of the modified contract. Moreover, the existence of the modification is, itself, an outcome that might be affected by workload, so sample selection is a concern when looking at the contractual terms of modifications. Within the class of definitive contracts, a given acquisition occurs either under simplified acquisitions procedures (for procurements below $150,000) or under the general acquisitions procedures. Simplified definitive contracts are referred to as purchase orders and make up the majority of the definitive contracts (about 1.3 million out of 1.4 million) but the minority of definitive procurement dollars (about $40 billion out of $420 billion in the sample).

In addition to the two sorts of definitive contracts, there is a third award type, referred to here as “delivery orders,” which consists of calls on IDVs. As discussed previously, an IDV is an umbrella contract that specifies a framework under which a broad class of specific procurements can be made. A delivery order is a specific agreement to procure under the broad terms of the IDV, but under the further terms and conditions particular to that specific procurement. A delivery order is a contract in its own right, with its own terms and modifications, but the contracting officer does not start from scratch, so his flexibility is somewhat limited. These contracts are very important, making up over 3 million of the 4.6 million original contracts, and more than half of all procurement spending (about $800 billion out of the $1.45 trillion in procurement spending by the DoD in our sample years).

There are four main features of contracts that contracting officers can adjust as their workloads vary. The first discretionary feature is the pricing structure. For simplicity, we divide the pricing structure of contracts into two broad categories: firm-fixed-price contracts and variable-price contracts. In fact, contracting officers can choose from a continuum of pricing structures, including firm fixed price; fixed price with various price adjustments, effort requirements, and incentive payments; cost plus fixed fee; cost plus various incentive fees; time and materials; and other various

hybrid forms. Firm-fixed-price contracts make up 88% of all original contracts in our sample. The FAR (2012) specifies that agencies should use fixed-price contracts when "the risk involved is minimal or can be predicted with an acceptable degree of certainty. (FAR, 16.103b)" Official government policy is to prefer firm-fixed-price contracts when possible.

The second discretionary feature available to contracting officers is the extent to which the contract is competed. The most competitive option, called "full-and-open competition," allows all responsible sources to compete. Full-and-open competition includes sealed bids, competitive proposals, and combinations of competitive procedures. Contracting officers can also choose a more limited form of competition called "full-and-open competition after exclusion of sources," which prohibits some otherwise qualified sources from participating in the competition. Sources may be excluded if doing so would reduce total costs without harming competition, aid national defense, maintain a reliable source, or fulfill a critical need. Officers are not required to report the reason for exclusion, but it is an optional data element. Among those who report (27%), the most commonly cited reasons are that a contract is a follow-on contract or has some unique sources. Finally, a contracting officer may choose not to compete a contract at all, either because a statue explicitly prohibits competition (not available for competition) or because only one source was solicited for reasons authorized by regulation and justified by the contracting officer (not competed). The most common justifications for not competing a contract are the availability of only one responsible source who can satisfy agency requirements, and unusual and compelling urgency.

Third, the extent to which a contracting officer completely specifies an original contract influences the probability of modification and the number of modifications of the original contract. There are several reported reasons for contract modifications. Over half of the reported modifications are strictly administrative, a funding only action, or a close out of a completed contract. But about 41% of modifications reflect a substantial change in the contract's requirements: unilateral requests for

additional work, change orders, the exercise of options, and bilateral supplemental agreements. The remaining 3% are an assortment of cancelations, terminations, and movements between definitive and indefinite contracts.

Finally, the choices the contracting officer makes with respect to competition, pricing terms, and modifications influence the size of the government's financial obligation from a contract. Every original contract has an initial level of expected obligation determined at the time of the contract award, which may be altered by later modifications. We look at initial and final obligation separately, since the model predicts individual effects on each.

Tables 11–13 present the summary statistics for the contract and agency features that form the basis for the regressions in our analysis. Table 11 presents the statistics for definitive contracts. The two major columns divide these contracts into firm-fixed-price and variable-price contracts, while the sub-columns further divide them into contracts that are eventually modified and those that are not. Each row is the sample mean and standard deviation from the indicated variable in the appropriate subset of contracts. The top panel includes contract-level variables, while the bottom panel includes agency-level variables, averaged over all the contracts of the indicated type. Tables 12 and 13 are similarly structured, but for purchase orders and delivery orders, respectively.

Table 11. Original Definitive Contracts

	Variable Price		Firm Fixed Price	
	No Mod.	Mod.	No Mod.	Mod.
Pct. Mod.	63		40	
Full and Open Comp.	0.281	0.396	0.416	0.392
	(0.450)	(0.489)	(0.493)	(0.488)
Excl. of Sources	0.410	0.434	0.278	0.231
	(0.492)	(0.496)	(0.448)	(0.421)
Not Comp.	0.0571	0.117	0.204	0.168
	(0.232)	(0.322)	(0.403)	(0.374)
Init Oblig ($M2009)	0.809	2.808	0.365	2.439
	(8.471)	(40.61)	(2.680)	(34.82)
Final Oblig ($M2009)	1.066	14.90	0.390	4.883
	(8.724)	(188.9)	(3.076)	(51.60)
Modifications	0	4.806	0	3.438
	(0)	(29.47)	(0)	(6.393)
Pct. Classified	0.138	0.127	0.0961	0.0837
	(0.190)	(0.184)	(0.143)	(0.159)
Pct. 10-20	0.202	0.204	0.177	0.192
	(0.0650)	(0.0554)	(0.0530)	(0.0586)
Pct. 20+	0.514	0.531	0.529	0.537
	(0.0865)	(0.0694)	(0.101)	(0.0937)
C. Officers	1105.2	1051.0	1346.9	940.6
	(977.0)	(913.6)	(1024.8)	(745.1)
n	6794	11306	57394	37665

Notes. Sample means and standard deviations for definitive contracts by pricing variety and eventual modification. The full sample includes contracts from 32 agencies over up to six years (2005–2010), although the Army agencies are limited to 2005–2008. Top-panel variables are contract-level data elements and bottom-panel variables are office-level data elements, weighted by the number of contracts.

Table 12. Purchase Orders

	Variable Price		Firm Fixed Price	
	No Mod.	Mod.	No Mod.	Mod.
Pct. Mod.	21		11	
Full and Open Comp.	0.335	0.204	0.558	0.358
	(0.472)	(0.403)	(0.497)	(0.479)
Excl. of Sources	0.111	0.208	0.219	0.258
	(0.314)	(0.406)	(0.414)	(0.437)
Not Comp.	0.438	0.458	0.197	0.330
	(0.496)	(0.498)	(0.398)	(0.470)
Init Oblig ($M2009)	0.125	0.0902	0.0248	0.0592
	(2.948)	(0.299)	(0.160)	(0.228)
Final Oblig ($M2009)	0.127	0.137	0.0252	0.0829
	(2.949)	(0.437)	(0.164)	(1.440)
Modifications	0	1.819	0	1.430
	(0)	(1.392)	(0)	(1.023)
Pct. Classified	0.0941	0.0623	0.0946	0.0598
	(0.103)	(0.139)	(0.107)	(0.135)
Pct. 10-20	0.190	0.211	0.172	0.196
	(0.0433)	(0.0530)	(0.0558)	(0.0671)
Pct. 20+	0.477	0.515	0.494	0.511
	(0.0766)	(0.0725)	(0.0829)	(0.101)
C. Officers	819.6	1077.9	1748.8	891.7
	(810.8)	(679.3)	(1059.8)	(794.5)
n	5200	1414	1.2M	143k

Notes. Sample means and standard deviations for purchase orders by pricing variety and eventual modification. The full sample includes contracts from 32 agencies over up to six years (2005–2010), although the Army agencies are limited to 2005–2008. Top-panel variables are contract-level data elements and bottom-panel variables are office-level data elements, weighted by the number of contracts.

Table 13. Delivery Orders

	Variable Price		Firm Fixed Price	
	No Mod.	Mod.	No Mod.	Mod.
Pct. Mod	15		9	
Full and Open Comp.	0.695	0.625	0.702	0.594
	(0.461)	(0.484)	(0.458)	(0.491)
Excl. of Sources	0.162	0.145	0.161	0.227
	(0.369)	(0.352)	(0.368)	(0.419)
Not Comp.	0.114	0.138	0.0955	0.110
	(0.318)	(0.345)	(0.294)	(0.313)
Init Oblig ($M2009)	0.203	1.277	0.0920	0.728
	(6.431)	(16.05)	(1.169)	(8.833)
Final Oblig ($M2009)	0.225	3.168	0.0939	1.004
	(6.508)	(50.02)	(1.201)	(12.79)
Modifications	0	2.446	0	1.846
	(0)	(3.813)	(0)	(2.385)
Pct. Classified	0.112	0.0815	0.108	0.0775
	(0.110)	(0.159)	(0.0810)	(0.144)
Pct. 10-20	0.184	0.202	0.163	0.195
	(0.0593)	(0.0572)	(0.0476)	(0.0584)
Pct. 20+	0.499	0.544	0.482	0.509
	(0.0719)	(0.0824)	(0.0621)	(0.0892)
C. Officers	1811.2	808.5	2090.4	1046.8
	(1027.6)	(773.5)	(901.1)	(829.9)
n	422k	77k	2.3M	241k

Notes. Sample means and standard deviations for delivery orders by pricing variety and eventual modification. The full sample includes contracts from 32 agencies over up to six years (2005–2010), although the Army agencies are limited to 2005–2008. Top-panel variables are contract-level data elements and bottom-panel variables are office-level data elements, weighted by the number of contracts.

For definitive contracts, 63% of the variable-price definitive contracts are eventually modified, while only 40% of the fixed-price definitive contracts are. This same pattern holds for the other two award types. We also see that, conditional on being modified, variable-price contracts are modified more frequently. Finally, there appear to be bigger changes to the variable-price contracts, at least in terms of the change in dollars obligated between the initial and final levels. This pattern is consistent with the idea that contracting officers choose variable-price contracts if renegotiation is likely.

The sample statistics reveal no obvious pattern of competition. For definitive contracts, the firm-fixed-price contracts appear to be more subject to full-and-open competition and less subject to exclusion of sources, but they are also more likely to be not competed at all. Purchase orders are similar, but for delivery orders there does not seem to be much difference in the use of competition among pricing terms.

Now consider workload. Firm-fixed-price contracts are, on average, being written by agencies with more contracting officers, across all three award types. For definitive contracts, the average firm-fixed-price contract is written in an agency with 1,184 contracting officers, while the average variable-price contract is written in an agency with 1,072 officers. The difference is even bigger for the other two award types. A similar pattern arises when comparing modified contracts to non-modified contracts within an award type and pricing class. For every award/pricing combination except for variable-price purchase orders (of which there are only 6,600), the average non-modified contract was written in an agency with many more contracting officers than was the average modified contract. Again, this pattern is consistent with the idea that agencies with many people to do the work write more complete contracts and make greater use of fixed-price contracts.

Finally, consider the distribution of contractual terms when we consider only those contracts performed in Iraq and Afghanistan. Table 14 presents those data for all award types pooled together. Essentially, there are two sets of contracts in Iraq and Afghanistan. There are a handful (about 600) of enormous variable-price delivery orders written off LOGCAP IV and related IDV umbrella contracts. These make up about 70% of the non-classified procurement spending in our sample of contracts in Iraq and Afghanistan. But even within this class there is some variation. For example, about a quarter of these delivery orders are executed as written, and it is still true that these unmodified contracts were written by agencies with more contracting officers on staff. The rest of the procurement in Iraq and Afghanistan is made up of a large collection of relatively small firm-fixed-price contracts (about 45,000). They are overwhelmingly subjected to full-and-open competition, rarely

modified, and mostly consist of purchase orders and relatively small definitive contracts.

Table 14. Contracts Performed in Iraq or Afghanistan

	Variable Price		Firm Fixed Price	
	No Mod.	Mod.	No Mod.	Mod.
Definitive	0	0.0409	0.163	0.290
	(0)	(0.198)	(0.369)	(0.454)
Purch Order	0.00641	0.00430	0.656	0.525
	(0.0801)	(0.0655)	(0.475)	(0.499)
Delivery	0.994	0.955	0.181	0.185
	(0.0801)	(0.208)	(0.385)	(0.388)
Full and Open Comp.	0.801	0.845	0.992	0.971
	(0.400)	(0.362)	(0.0914)	(0.167)
Excl. of Sources	0.128	0.0774	0.000960	0.00497
	(0.335)	(0.268)	(0.0310)	(0.0703)
Not Comp.	0.0256	0.0624	0.00693	0.0186
	(0.159)	(0.242)	(0.0830)	(0.135)
Init Oblig ($M2009)	6.156	19.62	0.211	1.433
	(16.30)	(72.64)	(2.754)	(6.182)
Final Oblig ($M2009)	8.524	86.14	0.210	1.928
	(33.29)	(573.6)	(3.080)	(11.12)
Modifications	0	5.065	0	2.064
	(0)	(7.449)	(0)	(6.007)
Pct. Classified	0.222	0.273	0.000919	0.00642
	(0.200)	(0.200)	(0.0150)	(0.0454)
Pct. 10-20	0.181	0.188	0.171	0.178
	(0.0460)	(0.0458)	(0.0110)	(0.0235)
Pct. 20+	0.524	0.546	0.653	0.609
	(0.0716)	(0.0543)	(0.0805)	(0.0721)
C. Officers	1645.7	1556.7	283.7	413.6
	(1065.7)	(987.8)	(183.3)	(399.3)
n	156	465	42k	4631

Notes. Sample means and standard deviations for contracts performed in Iraq and Afghanistan by pricing variety and eventual modification. The full sample includes contracts from 32 agencies over up to six years (2005–2010), although the Army agencies are limited to 2005–2008. Top-panel variables are contract-level data elements and bottom-panel variables are office-level data elements, weighted by the number of contracts.

Although the patterns in the sample statistics are broadly consistent with our explanation for the role of contracting officer workload, differences in sample means could very easily be driven by numerous factors that just happen to be correlated

with the number of contracting officers. In the next section, we control for many of these factors econometrically in order to uncover the direct relationship between workload and contractual terms.

Econometric Specification of Workload

Designing a measure of workload that is consistent across agencies and time is challenging for several reasons. For example, the problems of using straightforward workload measures, such as the number of contracts per officer or dollars obligated per officer, have been well established (Black, 1995; Reed, 2010) and are present here as well. The degree of contract complexity varies across agencies, so simply adding up the number of contracts or dollars would overstate the workload of officers in those agencies who have relatively simple tasks to perform and understate the workload of officers in those agencies with relatively complex tasks. Since contracting officers' choices of the procurement and contractual terms are impacted by the product or service's complexity, these simple measures of workload would produce biased results. As a result, we do not try to directly estimate the workload per officer. Instead, we focus on the impact of changes in the total number of contracting officers in an agency, while controlling for the number and mix of contracts the officers must manage.

Others have attempted to create consistent measures of workload by applying an ex-ante weighting scheme among contracts (AFIMA, 2001; Reed, 2010). However, these weighted measures of workload are infeasible for this study for a couple of reasons. First, some of these measures do not account for variance in cross-agency time use, and, therefore, cannot be consistently applied in a cross-agency study. Second, workload measures that can be applied consistently across agencies use weights that depend on the very outcomes we want to examine: dollars obligated, extent competed, and solicitation procedures. Using a workload measure that depends on any of these equilibrium outcomes would produce biased results.

Given the problems with these ex-ante workload weights, we will instead take a flexible approach, letting the data determine the work intensity of various contracting actions. To measure the workload, we include a variable for (the log of) the number of contracting officers in each agency/year combination. To control for the contract mix, we count the (log of) the number of original contracts for each of 55 different product/services classes for each agency/year combination. These counts are then included in each regression as 55 separate controls, indexed by j.

Another concern with appropriately measuring workload is that many defense contracts are classified and are not reported for national security reasons. If the share of contracts varies across agencies, then our workload measures will understate the workload of agencies with many unreported contracts and overstate the workload of agencies with few or no classified contracts. To control for this, we include a proxy of the intensity of classification in the office—the fraction of the *branch's* procurement budget that is classified in the fiscal year. Unfortunately, this measure is only available at the branch level (Army, Navy, Air Force, and other-DoD) and not at the individual office level.

Finally, every regression will include measures of contracting-officer experience, including the fraction with 10–20 years of experience and the fraction with over 20 years of experience, agency fixed effects and trends, a year fixed effect, and product/service fixed effects. Formally, we estimate the following fixed-effects OLS (FE-OLS) equation for contract i, in product class p, in agency s, in year t.

$$y_{ipst} = \beta_1 CO_{st} + \beta_2 CO_{st} * IA_{ipst} + \eta IA_{ipst} + \delta' E_{st} + \sum_{j=1}^{55} (\propto_j X_{jst}) + \sigma C_{st} + \gamma_{pst} + \kappa_s year_t + \in_{ipst} \quad (3)$$

where employment (CO) and contract counts (X) are measured in logs, IA is a dummy variable equal to one for a contract performed in Iraq or Afghanistan, E is the vector of experience controls, C_{st} is the share of classified procurement, γ_{pst} is the combination of three fixed effects (agency, year, and product class), $\kappa_s year_t$ is an agency-specific year trend, and y is the outcome of interest. Across various contracting outcomes, our interest is in estimating the βs, the effect of expanding the contracting workforce on that outcome. Intuitively, β reflects the change in contracting outcomes for an agency when its number of contracting officers deviates from trend, given contract load, mix, and experience, while controlling for agency, year, and product-specific factors. The errors among contracts in a given agency-year will likely be correlated, so we will cluster our standard errors at the agency-year level for inference.

The econometric approach here is very similar to the approach in the Civilian analysis, but it differs in two ways. First, we are not able to avail ourselves of the instrumental-variable strategy of using retirements as a shock to workload. Since the DoD procurement offices are much larger than those found in most civilian agencies, they have about three times as many GS-1102s, on average. By the law of large numbers, this increased size irons out much of the random variation in retirement rates. Unfortunately, this leads to a very weak and non-robust first-stage relationship between retirement rates and contracting-officer employment in the DoD agencies. Without an IV strategy, we are particularly concerned with omitted variable bias if agency mission changes over time (since that would not be captured in agency fixed effects). For this reason, we introduce a second difference from Warren—the introduction of agency-specific time trends. This more flexible specification will be robust to omitted factors that vary within an agency, over time, as long as they trend roughly with time. Finally, it is important to note that the biases Warren uncovered for the OLS regressions were all biases toward zero, so if the underlying omitted variables are similar here, we can at least sign the bias of our estimated coefficients.

DoD Results

Modifications

Table 15 outlines the estimated relationship between decreasing workload and the presence and number of substantive modifications or terminations. For this analysis only, we limit the sample to contracts written before 2009, since enough time must pass to observe any modifications. The first column presents estimates for the sample of definitive contracts, while the second and third present purchase orders and delivery orders, respectively. Our expectation is that busier contracting offices should write less complete contracts, leading to an increase in ex-post renegotiation and reflected in increased rates of modification and termination.

Table 15. The Effect of Workload on Renegotiation

	Def. Contract	Purch. Order	Del. Order
Panel A: Termination			
C. Officers	−0.08**	−0.06***	−0.03*
	(0.04)	(0.01)	(0.02)
C. Officers x IorA	0.03*	−0.02	0.01
	(0.02)	(0.01)	(0.01)
Iraq or Af.	−0.11	0.12	−0.05
	(0.08)	(0.08)	(0.05)
Pct. 10-20	0.14*	0.24***	−0.11***
	(0.08)	(0.02)	(0.01)
Pct. 20+	−0.10*	−0.00	−0.09*
	(0.06)	(0.01)	(0.05)
Panel B: Any Substantive Modifications			
C. Officers	−0.39***	0.37**	−0.64**
	(0.11)	(0.18)	(0.27)
C. Officers x IorA	0.09*	−0.23**	0.15***
	(0.05)	(0.09)	(0.06)
Iraq or Af.	−0.48	1.60***	−0.95**
	(0.35)	(0.64)	(0.39)
Pct. 10-20	−0.80***	1.31***	−1.13***
	(0.17)	(0.39)	(0.23)
Pct. 20+	0.39***	−0.42	−0.82
	(0.15)	(0.33)	(0.64)
Panel C: Number of Substantive Modifications			
C. Officers	−2.16***	0.40***	−1.17**
	(0.21)	(0.14)	(0.53)
C. Officers x IorA	0.16*	−0.29***	0.14
	(0.09)	(0.10)	(0.11)
Iraq or Af.	−0.88	2.03***	−0.71
	(0.59)	(0.68)	(0.74)
Pct. 10-20	0.51	0.95***	−0.78***
	(0.65)	(0.32)	(0.31)
Pct. 20+	1.89***	−0.42	−1.86
	(0.25)	(0.27)	(1.30)
n	89k	0.97M	2.7M

Notes. Panel A Dependent Variable: Indicator of a contractual termination. Panel B Dependent Variable: Indicator of a subsequent substantive modification. Panel C Dependent Variable: The log of one plus the number of substantive modifications. Definitive contracts are included in specification 1, purchase orders in specification 2, and delivery orders in specification 3. In addition to the tabulated regressors, each specification includes the log of the number of original contracts in 55 product/service groups, product/service fixed effects, agency fixed effects and trends, and year fixed effects. The full sample includes contracts from 32 agencies over up to four years (2005–2008). Standard errors, in parenthesis, are clustered by agency-year.*,**,*** represent significance at the 0.10, 0.05, and 0.01 levels, respectively.

All three show significant effects of workload on contract terminations, in the expected direction for non-Iraq/Afghanistan contracts. Increasing the number of contracting officers by about 10% when the original contract is signed decreases the probability that the contracted is later terminated by between 0.3 and 0.8 percentage points, on a mean of less than 1%. The relationship for contracts in Iraq and Afghanistan seems weaker, but it is difficult to make much of these result, since less than 0.1% of such contracts are ever terminated.

The results for modifications are more mixed. For definitive contracts and delivery orders, more contracting officers are associated with fewer modifications, along both the extensive and intensive margins. In particular, increasing the number of contracting officers by 10%, decreases the probability of modification by about 3–6 percentage points, and decreases the expected number of modifications by 10–20%. These relationships may be slightly weaker for contracts in Iraq/Afghanistan, but they are substantively quite similar. Purchase orders, by contrast, seem to be more modified as workload declines, at least for contracts not performed in Iraq and Afghanistan. In Iraq and Afghanistan, there seems to be no relationship between workload and modification of purchase orders.

To judge the size of these effects, about 10% of delivery contracts and purchase orders in the sample are modified at some point, while about 40% of definitive contracts are. The average delivery or purchase order has about 0.18 modifications, while the average definitive contract has about 1.8.

Consistent with the predictions of the model and the evidence for civilian agencies, as workload declines, agencies seem to do a better job at foreseeing contingencies in the original contract and delivery orders, thereby limiting the need for ex-post renegotiation or termination. This relationship also holds up for the presumably simpler acquisition task of purchase orders, in the case of terminations, but seems to reverse for modifications. We will see this pattern throughout much of our analysis, where the model does well in prediction behavior on relatively difficult contracts, but falls short in explaining behavior on the simple purchase orders.

Degree of Competition

Table 16 outlines the estimated relationship between workload and the decision to award a contract by competitive mechanisms. For definitive contracts and delivery orders, more contracting officers are associated with increased use of competitive procurement mechanisms. In particular, increasing the number of contracting officers by 10% increases the probability of full-and-open competition by about 2–4 percentage points, decreases the use of competition with excluded sources by about 1 percentage point, and decreases the probability that a contract is not competed at all by between 1 and 2 percentage points. The effects may be slightly stronger for contracts performed in Iraq and Afghanistan, but the difference is not substantively very large. To give a sense of magnitudes, about 40% of definitive contracts and 69% of delivery orders are fully and openly competed, while about 28% and 17%, respectively, are competed after exclusion. Finally, about 10% of delivery orders and 18% of definitive contracts are not competed at all. Again, we find no consistent relationship between workload and competition for purchase orders.

Table 16. The Effect of Workload on Competition

	Def. Contract	Purch. Order	Del. Order
Panel A: Full and Open Competition			
C. Officers	0.37***	0.03	0.18***
	(0.13)	(0.12)	(0.04)
C. Officers x IorA	0.11**	−0.24	0.02
	(0.05)	(0.18)	(0.06)
Iraq or Af.	−0.37	2.03*	0.18
	(0.34)	(1.23)	(0.43)
Pct. 10-20	0.32	0.12	0.18*
	(0.40)	(0.38)	(0.10)
Pct. 20+	−0.01	−0.33	0.15*
	(0.35)	(0.27)	(0.08)
Panel B: Competition with Exclusion			
C. Officers	−0.13	−0.05	−0.09***
	(0.14)	(0.10)	(0.03)
C. Officers x IorA	−0.02	0.09	0.01
	(0.03)	(0.06)	(0.02)
Iraq or Af.	−0.04	−0.92**	−0.33***
	(0.21)	(0.42)	(0.13)
Pct. 10-20	−0.59	−0.23	−0.31***
	(0.40)	(0.36)	(0.08)
Pct. 20+	0.07	0.61**	−0.05
	(0.33)	(0.28)	(0.06)
Panel C: Not Competed			
C. Officers	−0.18**	0.12	−0.10**
	(0.08)	(0.08)	(0.04)
C. Officers x IorA	−0.06	0.07	−0.05
	(0.05)	(0.15)	(0.05)
Iraq or Af.	0.37	−0.54	0.36
	(0.35)	(0.99)	(0.37)
Pct. 10-20	−0.04	0.39**	0.16**
	(0.17)	(0.16)	(0.08)
Pct. 20+	0.03	−0.33**	−0.12*
	(0.17)	(0.16)	(0.07)
n	113k	1.36M	3.03M

Notes. Dependent variable: Indicator of use of given level of competition. Not available for competition is the excluded class. Definitive contracts are included in specification 1, purchase orders in specification 2, and delivery orders in specification 3. In addition to the tabulated regressors, each specification includes the log of the number of original contracts in 55 product/service groups, product/service fixed effects, agency fixed effects and trends, and year fixed effects. The full sample includes contracts from 32 agencies over up to six years (2005—2010). Standard errors, in parenthesis, are clustered by agency-year. *,**,*** represent significance at the 0.10, 0.05, and 0.01 levels, respectively.

This shift toward competitive acquisitions procedures as the contracting workforce increases is exactly what the model predicts and is consistent with the results for civilian agencies.

Pricing Structure

Table 17 presents the estimated relationship between decreasing workload and the pricing structure chosen by the contracting officer. Agencies with more contracting officers than we would expect, given their mix of contracts, seem to be less likely to use firm-fixed-price contracts, at least for definitive contracts and purchase orders performed outside of Iraq and Afghanistan and for delivery orders performed in Iraq or Afghanistan. Increasing the number of contracting officers by 10% is associated with a decrease in the use of firm-fixed-price contracts of between 2 and 3 percentage points. This is on a mean of about 83% for delivery orders and definitive contracts, and a mean of more than 99.5% for purchase orders. Note, however, that within Iraq and Afghanistan, these rates rise to nearly 100% for definitive contracts and purchase orders and to 93% for delivery orders, so the coefficients for the Iraq/Afghanistan sample should be interpreted with care.

Table 17. The Effect of Workload on Contract Pricing

	Def. Contract	Purch. Order	Del. Order
	Use of Firm-Fixed-Price Contracts		
C. Officers	−0.19**	−0.05*	−0.16
	(0.09)	(0.03)	(0.13)
C. Officers x IorA	0.04	0.02***	−0.16**
	(0.04)	(0.01)	(0.08)
Iraq or Af.	−0.29	−0.11***	1.02**
	(0.27)	(0.04)	(0.51)
Pct. 10-20	−0.02	−0.16**	−0.33
	(0.14)	(0.07)	(0.33)
Pct. 20+	−0.05	0.03	−0.46
	(0.14)	(0.06)	(0.29)
n	113k	1.36M	3.03M

Notes. Dependent variable: Indicator of use of a firm-fixed-price contract. Definitive contracts are included in specification 1, purchase orders in specification 2, and delivery orders in specification 3. In addition to the tabulated regressors, each specification includes the log of the number of original contracts in 55 product/service groups, product/service fixed effects, agency fixed effects and trends, and year fixed effects. The full sample includes contracts from 32 agencies over up to six years (2005–2010). Standard errors, in parenthesis, are clustered by agency-year. *,**,*** represent significance at the 0.10, 0.05, and 0.01 levels, respectively.

Nevertheless, this result is quite at odds with the prediction of the model and the evidence in civilian agencies. This divergence suggests that our framework may be ignoring some factor guiding the pricing decision in the DoD that was not in play in the civilian agencies. As discussed in the section Complex Contracting Environments, many fixed-price contracts written by the DoD are highly cost based and, therefore, depress the cost-saving incentives generated by more typical fixed-price contracts. As fixed-price contracts become more like cost-plus contracts, the estimated effect of workload should fall toward zero as contracting officers become indifferent between fixed-price contracts and cost-plus contracts. However, this story cannot explain why the estimated effect shifts from positive to negative.

Obligations

Table 18 outlines the estimated relationship between workload and the initial and final amount obligated on the contract, taking into account later adjustments

when applicable. For definitive contracts and purchase orders, outside Iraq and Afghanistan, a higher number of contracting officers is associated with lower initial and final obligations, although the effect is bigger for initial than for final obligations. The relationship seems to be weaker for contracts performed in Iraq and Afghanistan, but for definitive contracts, at least, it is still quite large. For definitive contracts, increasing the number of contracting officers by 10% would decrease initial obligations by 5–6.5% and decrease final obligations by about 5%. These results are consistent with the model and the results for civilian agencies.

Table 18. The Effect of Workload on Obligations

	Def. Contract	Purch. Order	Del. Order
Panel A: Initial Dollars Obligated			
C. Officers	−0.65***	−0.22**	−0.12
	(0.24)	(0.10)	(0.17)
C. Officers x IorA	0.17	0.06	0.41*
	(0.17)	(0.38)	(0.24)
Iraq or Af.	0.24	0.20	−0.64
	(1.13)	(2.60)	(1.61)
Pct. 10-20	−1.42**	0.41*	−0.61
	(0.67)	(0.24)	(0.80)
Pct. 20+	0.11	0.31*	−0.76
	(0.53)	(0.19)	(0.65)
Panel B: Total Dollars Obligated			
C. Officers	−0.55**	−0.14	0.06
	(0.26)	(0.10)	(0.18)
C. Officers x IorA	0.07	0.11	0.43
	(0.21)	(0.40)	(0.27)
Iraq or Af.	0.58	−0.15	−0.75
	(1.40)	(2.72)	(1.82)
Pct. 10-20	−1.03	0.42*	0.16
	(0.74)	(0.24)	(0.81)
Pct. 20+	−0.09	0.35*	−0.26
	(0.62)	(0.19)	(0.65)
n	113k	1.36M	3.03M

Notes. Dependent variables: The natural log of the initial and final (to date) obligations, measured in real 2009 dollars. Definitive contracts are included in specification 1, purchase orders in specification 2, and delivery orders in specification 3. In addition to the tabulated regressors, each specification

includes the log of the number of original contracts in 55 product/service groups, product/service fixed effects, agency fixed effects and trends, and year fixed effects. The full sample includes contracts from 32 agencies over up to six years (2005–2010). Standard errors, in parenthesis, are clustered by agency-year. *,**,*** represent significance at the 0.10, 0.05, and 0.01 levels, respectively.

There is some evidence that the relationship could go the other way for delivery orders, at least in Iraq and Afghanistan, although the effect is not quite statistically significant at conventional levels. This interaction is particularly interesting because it suggests that increases in the size of the contracting workforce are unlikely to lead to much cost cutting on the large delivery orders that make up such a large part of the procurement in Iraq and Afghanistan.

Contract Types

To this point, we analyzed the three major contract award types in parallel. For many procurement decisions, the contracting award type is more or less dictated by the object and context of the procurement. But there are always marginal cases, and it is important to understand the patterns of substitution among the award type for at least two reasons. First, one of the worries cited by the Commission on Wartime Contracting in Iraq and Afghanistan (2011) is that inadequate staffing of contracting offices operating in Iraq and Afghanistan has led them to depend inappropriately on the use of delivery orders, when one-off definitive contracts would have been more appropriate. We can investigate this question empirically.

Second, in our analysis we sometimes found that the relationship between workload and contracting outcomes differed by award type. If there was a big substitution among award type, we might worry that these difference were caused simply by sample selection. Take the example of modification. We found that higher workload was associated with more modification of delivery orders and definitive contracts, and lower modification of purchase orders. If we found that increased workload was also associated with substitution from purchase orders relative to those other two award types, we might worry that there is no real effect on modification and, instead, the contracting officers are simply changing the contracts

they are likely to eventually modify from delivery orders or definitive contracts into purchase orders.

In fact, we find that all the substitution seems to occur between definitive contracts and delivery orders. Table 19 presents these estimates, where each column is a single regression with an indicator for the named award type as the dependent variable. For contracts not performed in Iraq or Afghanistan, we find that having more contracting officers is associated with an increased use of definitive contracts and a decreased use of delivery contracts. There is no statistically significant evidence of a change in the frequency of purchase orders. Increasing the number of contracting officers in an agency by about 10% would increase the use of definitive contracts by about 0.6 percentage points, decrease the use of delivery orders by about 1.2 percentage points, and increase the use of purchase orders by (a statistically insignificant) 0.6 percentage points. On average, only about 2.5% of original contracts are definitive contracts, 67% are delivery orders, and 30% are purchase orders.

Table 19. The Effect of Workload on Award Type

	Def. Contract	Purch. Order	Del. Order
C. Officers	0.06^{***}	0.06	-0.12^{***}
	(0.02)	(0.04)	(0.04)
C. Officers x IorA	-0.05^{***}	0.02	0.03
	(0.02)	(0.04)	(0.04)
Iraq or Af.	0.37^{***}	-0.20	-0.17
	(0.13)	(0.25)	(0.29)
Pct. 10-20	-0.02	0.37^{***}	-0.35^{***}
	(0.07)	(0.11)	(0.14)
Pct. 20+	-0.10^{**}	0.34^{***}	-0.24^{**}
	(0.04)	(0.09)	(0.10)
n		4.5M	

Notes. Dependent variable: An indicator of the specified award type. Definitive contracts are in specification 1, purchase orders in specification 2, and delivery orders in specification 3. In addition to the tabulated regressors, each specification includes the log of the number of original contracts in 55 product/service groups, product/service fixed effects, agency fixed effects and trends, and year fixed effects. The full sample includes contracts from 32 agencies over up to six years (2005–2010). Standard errors, in parenthesis, are clustered by agency-year. *,**,*** represent significance at the 0.10, 0.05, and 0.01 levels, respectively.

Although this substitution among award types is not formally explored in the model, we believe it is consistent in spirit. If we think about delivery orders as starting off with a partially written contract and simply filling in the details, their use might be particularly attractive to a heavily burdened contracting officer, relative to a definitive contract that he would need to write from scratch and award independently.

For contracts in Iraq and Afghanistan, the case that brought this issue to the front of the policy debate, we actually find very little substitution. Certainly, there is no significant difference in the use of definitive contracts as workload changes. There may be some substitution toward delivery orders and away from purchase orders as workload increases, but the estimates are not statistically significant. We conclude that the case that this sort of substitution is particularly rampant for contracts performed in Iraq and Afghanistan is weak. On the contrary, our data suggest that it is a general fact about contracting and, if anything, is less evident for contracts in Iraq and Afghanistan.

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Summary of DoD Analysis and Conclusion

This paper has explored how the variation in contracting officer workload in civilian agencies and in the Department of Defense (DoD) is related to contractual outcomes. We find evidence that higher workloads induce contracting officers to write less complete contracts. This reduction in contractual completeness increases the probability of modification, so contracting officers are less likely to award contracts through full-and-open competition. Contrary to theoretical predictions and the civilian analysis, we find a positive relationship between workload and the use of fixed-price contracts. Some of this relationship between workload may be attributable to the combination of sole-source environments and the Truth in Negotiations Acts (1962, § 2306a) that mitigate the advantages of fixed-price contracts over more flexible cost-plus contracts. Finally, we find that when workload is high, contracting officers are more likely to make calls on existing indefinite delivery vehicles rather than write and award new definitive contracts. With the exception of pricing terms, our results square directly with the parallel analysis of civilian contracting offices.

This paper also addresses a pressing policy question about the drivers of sub-optimal procurement outcomes in Iraq and Afghanistan contracts. We find that decreasing workload increases the use of competition, increases the probability and frequency of renegotiation, and reduces the initial and final price paid. However, with the exception of competition, the effect of workload is more important for contracts procured outside of Iraq and Afghanistan. Moreover, in contrast to the conclusion of the Commission on Wartime Contracting in Iraq and Afghanistan (2011), we do not find significant evidence that higher workload causes contracting officers to prefer indefinite delivery vehicles over definitive contracts. Our results suggest that increases in the size the acquisitions workforce will affect domestic procurement at least as much as it will affect procurement in Iraq and Afghanistan.

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Appendix (Proof)

Let $P_{x,y}$ and $R_{x,y}$ represent the expected prices paid under contract form x and competition choice y, for the original contract and in a renegotiation, respectively. Given choices (x, y, t), the expected utility of the contracting officer is given by

$$U(x,y,t) = v - wd(t) - x[y(tP_{11} + (1-t)R_{11} + m) + (1-y)(tP_{10} + (1-t)R_{10})] \\ - (1-x)[y(tP_{01} + (1-t)R_{01} + m) + (1-y)(tP_{00} + (1-t)R_{00})] \quad (4)$$

Start by deriving the prices. In the last stage of the game, contractors make effort decisions. Under a cost-plus contract, they have no incentive to put forth effort, since any cost reductions will be directly subtracted from their payments, so $e_{cp} = 0$. Under a fixed-price contract, contractors are residual claimants of any cost reductions, so they will set effort to satisfy $g'(e_{fp}) = 1$. Let $f = e_{fp} - g(e_{fp})$ represent the net real-cost savings of this efficient effort.

By assumption, in the renegotiation stage, the contractor will be pushed to zero profits by a take-it or leave-it offer from the contracting officer. In a cost-plus contract, this just amounts to offering no additional "plus" and simply reimbursing costs, so the expected price is simply $E[k]$, whether or not the initial contract was competed (so $R_{0,1} = R_{0,0} = E[k]$). Here, the competitive contractor has lost the "plus" part of his cost-plus contract, due to the extreme bargaining power we assumed. The results are unaffected if we instead assume he keeps that portion. In a fixed-price contract, the contracting officer and contractor anticipate the cost-saving effort by the contractor and so the expected total cost is $E[k] - f$, which requires a payment of $R_{1,1} = R_{1,0} = (1+\delta)(E[k] - f)$.

Moving back to the original pricing stage, expected payments under negotiation are straightforward from the zero-profit condition. The difference between fixed-price and cost-plus contracts are similar to that presented in the

previous discussion, where total cost is reduced by non-contractible effort, so $P_{1,0} = E[c] - f$ and $P_{0,0} = E[c]$. We assumed that competition results in the lowest-cost producer producing at the second-lowest "bid." Immediately $P_{1,1} = E[c_2] - f$ and $P_{0,1} = E[c_2]$, where c_2 is the second-lowest cost. With these prices in hand, I first show that $t*$ decreases in w and then that $x*$ and $y*$ increase in t while w has no direct effect, so they decrease in w, overall.

Consider some set of strategies (x, y, t_1) and some alternative set (x, y, t_2), where $t_1 > t_2$. We can write the difference in the contracting officer's expected utility using these two sets of strategies as follows:

$$U(x, y, t_1) - U(x, y, t_2) = A(x, y, t_1 t_2) - w\big(d(t_1) - d(t_2)\big),$$

where $A(\cdot)$ is independent of w, since w only appears in the cost of contractual completeness. By the assumption that $d(\,)$ is increasing, it follows immediately that this difference strictly increases $-w$, so the contracting officer's expected utility has strictly increasing differences in $(-w, t)$.

Consider some set of strategies $(1, y, t)$ and some alternative set $(0, y, t)$. We can write the difference in the contracting agent's expected utility using these two sets of strategies as follows:

$$U(1, y, t) - U(0, y, t) = -t\big(P_{1,y} - P_{0,y}\big) - (1 - t)\big(R_{1,y} - R_{0,y}\big).$$

Replacing for the prices derived previously, this difference becomes

$$U(1, y, t) - U(0, y, t) = f - (1 - t)\delta[Ek - f],$$

which is strictly increasing in t and independent of w and y.

Finally, consider some set of strategies $(x, 1, t)$ and some alternative set $(x, 0, t)$. We can write again the difference in the contracting officer's expected utility using these two sets of strategies as follows,

$$U(x,1,t) - U(x,0,t) = -t\left(P_{x,1} - P_{x,0}\right) - (1-t)\left(R_{x,1} - R_{x,0}\right) - m.$$

Replacing for the prices derived previously, this difference becomes

$$U(x,1,t) - U(x,0,t) = t\left[E[c] - E[c_2]\right] - m,$$

which is strictly increasing in t and independent of w and x.

Taken together, I have shown that the contracting officer's objective function has increasing differences in x, y, t, and $-w$, and the increases with respect to t are all strict. By the results of Topkis (1998), this suffices to show that $t*$, $x*$, and $y*$ weakly increase in $-w$, so weakly decrease in w.

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